MODEL 9601
TRANSMISSION MEASUREMENT SET
INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WILTRON

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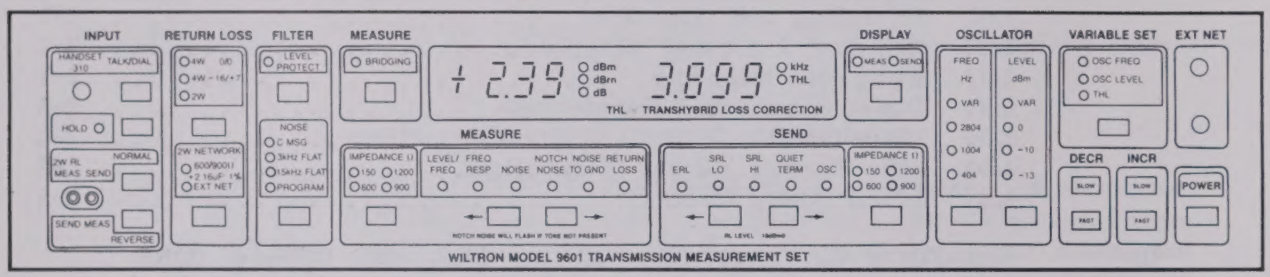

Figure 1-1. WILTRON Model 9601 Transmission Measurement Set

SECTION I

GENERAL DESCRIPTION

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1. INTRODUCTION

The WILTRON 9601 Transmission Measurement Set (Figure 1-1) is capable of sending a tone, providing a quiet termination, and measuring level and frequency, frequency response, noise, notched noise, noise-to-ground, or return loss (echo return loss and singing return loss) on 2-wire or 4-wire circuits. It also has a talk/dial and hold capability and can be mounted in a 19-inch or 23-inch relay rack and uses -48 Vdc power.

This manual also includes interconnection and mounting information for WILTRON 9496 Remote Display Units (paragraph 1.02).

1.01 9601 TRANSMISSION MEASUREMENT SET

The 9601 is divided into two main operating functions: sending and measuring. The sending group consists of the oscillator, quiet termination, and return loss functions. The measuring group consists of the level and frequency, frequency response, noise, notched noise, noise-to-ground, and return loss functions. The TMS display can be set to indicate either the sending or measuring values.

A. Oscillator and Quiet Termination Functions

The oscillator output level, frequency, and impedance are set individually. The oscillator can be set to one of three preset levels (0.0, -10.0, or -13.0 dBm), or to a level between +12.0 and -40.0 dBm (in 0.1 dB increments) in the variable mode.

The oscillator frequency can be set to one of three preset frequencies (404, 1004, 2804 Hz), or to a frequency between 50 Hz and 20.0 kHz (in one Hz increments from 50 to 4099 Hz and 10 Hz increments from 4100 Hz to 20.0 kHz) in the variable mode.

The 9601 has an SF and 4000 Hz skip feature that prevents the oscillator from sending out tones between 2450 and 2750 Hz and between 3980 and 4020 Hz when the INCR FAST or DECR FAST buttons are pressed. This feature can be overrid-

den by pressing the INCR SLOW or DECR SLOW buttons to set the frequency.

The quiet termination function is provided for far-end-to-near-end noise tests.

B. Level/Frequency and Frequency Response Measurement Functions

The 9601 measures levels from +12.0 to -52.0 dBm (+10.0 to -52.0 dBm on 1200-ohm circuits) in either a bridged or terminated mode. The 9601 has a built-in 60 Hz line filter for return loss measurements and a switchable high/low band pass noise protection filter for level measurements (meets AT&T PUB 41009 specifications). The frequency measuring range is 50 Hz to 20.0 kHz.

Also, the 9601 can perform frequency response measurements directly. When this mode is selected, the first level measured becomes the 0 dB reference. As the test frequency changes, all other measured levels are then displayed in dB relative to the reference level.

C. Noise, Notched Noise, and Noise-to-Ground Measurement Functions

The 9601 measures bridging metallic noise from 10 to 90 dBrn and noise to ground from 50 to 130 dBrn in the terminated mode (150, 600, 900, or 1200 ohms).

Noise measurements are performed with one of four selectable noise filters: C-Message, 3 kHz Flat, 15 kHz Flat, or Program. A 995-to-1025 Hz notch noise function is also provided for noise measurements on PCM or other carrier circuits with compandors. In this mode, the NOTCH NOISE LED flashes when a 1004 Hz (holding) tone is absent from the circuit under test.

D. Return Loss Measurement Function

The 9601 measures echo return loss (ERL) and singing return loss (SRL) on 2-wire (600 or 900 ohms) or 4-wire circuits (150, 600, 900, or 1200 ohms). The input and output impedances are selected simultaneously using either the SEND or MEASURE IMPEDANCE Ω button.

In the return loss mode, the 9601 sends out -10.0 dBm of white noise through one of three selectable band filters: echo return loss (ERL), 560 to 1965 Hz; singing return loss low (SRL LO), 260 to 500 Hz; or singing return loss high (SRL HI), 2200 to 3400 Hz. The 9601 then measures the return loss of the circuit under test from -10 dB (10 dB return gain) to +50 dB.

The return loss receiver of the 9601 has a protection filter which prevents 60 Hz or other low-frequency spurious signals from affecting return loss measurements.

For 4-wire return loss measurements, a trans-hybrid loss (THL) correction is provided. The THL correction value can be varied from +30.0 to -20.0 dB in 0.1 dB steps (negative values compensate for overall circuit gain). The 9601 also provides a +7/-16 send/measure level for circuit testing on carrier circuits.

For 2-wire circuits, the 9601 references return loss measurements to either an internal or external network. The internal network consists of a 600-ohm or 900-ohm, ±0.1% resistor (depending upon the selected input impedance) in series with a 2.16 microfarad ±1% capacitor. The external network connects to the 9601 in one of two ways. It can be connected to the EXT NET jacks on the front panel or to the rear panel connector P3 (refer to paragraph 2.05 for wiring instructions).

E. Accessing the Circuit Under Test

The 9601 accesses the circuit under test via either the front panel send and measure jacks or external send and measure leads. The front panel jacks have priority over the external leads. The external send and measure leads are connected to the cutoff contacts of front panel send and measure jacks. The external send and

measure leads can be connected to rear panel connector P3 (refer to paragraph 2.05 for wiring instructions).

Also, the front panel send and measure jacks can be reversed by pressing the REVERSE button. This feature allows either the oscillator or level/noise receiver to be connected to the circuit under test without dropping the call.

F. Talking/Dialing and Holding a 2W Circuit on the 9601

The 9601 has a feature for using a handset to dial and talk on a two-wire circuit. The two-wire circuit to be dialed is patched to the 9601 measure jack. After the circuit is dialed, the 9601 hold circuitry is activated and the two-wire circuit is connected to the 9601 sending circuitry so that oscillator test, noise tests (quiet termination), or return loss measurements can be performed while holding.

G. Audio Monitoring of Circuits Under Test

Audio monitoring of circuits under test to diagnose noise problems can be accomplished by wiring an external speaker to the 9601 via rear panel connector P3.

1.02 9496 REMOTE DISPLAY

The WILTRON Model 9496 Remote Display (Figure 1-2) provides remote readings of the level and frequency, frequency response, noise, and return loss measurements. The remote display uses a serial protocol to communicate with the 9601. It is powered locally (-48 Vdc) and requires a two-wire twisted pair for communication with the 9601. Up to six remote displays can be connected to a 9601. The total cable distance between the 9601 and up to six 9496s must not exceed 2000 feet.

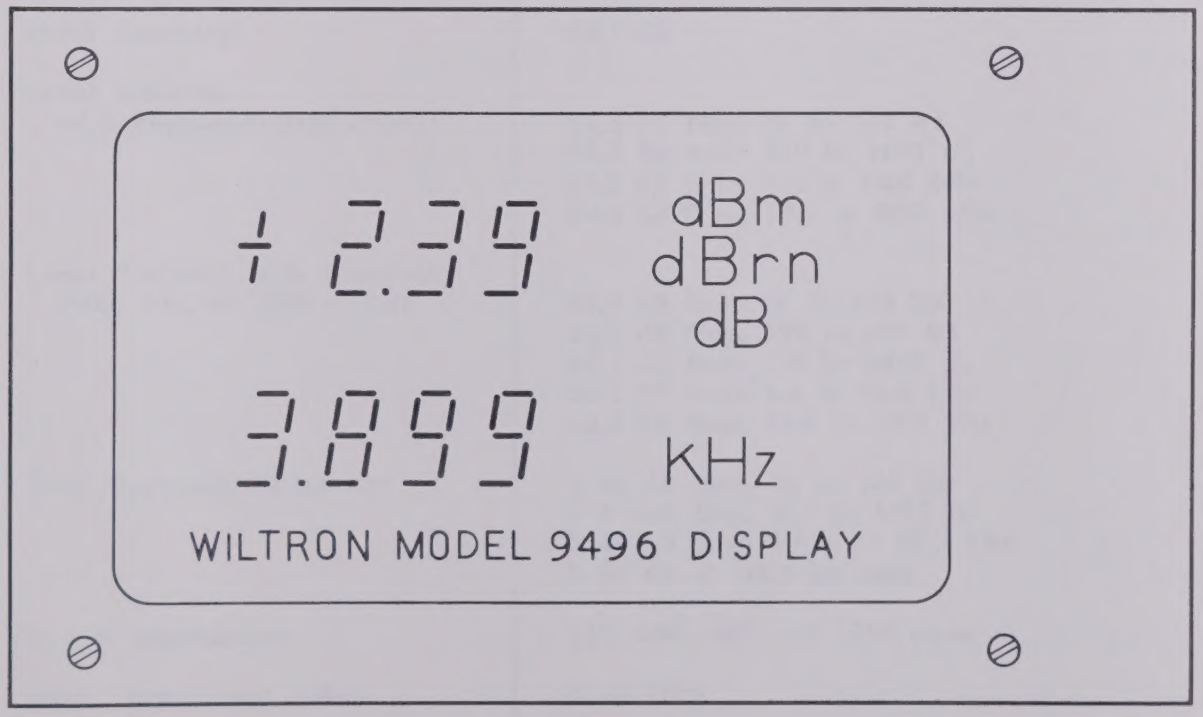

Figure 1-2. Model 9496 Remote Display

1.03 EQUIPMENT MOUNTING

The 9601 is available only as a rack-mounted unit. Each unit occupies two rack spaces (3-1/2 inches). Reversible rack ears can be mounted on the 9601 to provide flush or 5-inch extended mounting in either 19-inch or 23-inch relay racks.

The 9496 is normally mounted with a WILTRON-supplied bracket to a customer-supplied ceiling rod (see Figure 2-3). This arrangement allows the display to be rotated horizontally to the desired position. Also, an optional wall mounting bracket (WILTRON P/N 3463-3) is available to mount the display to a wall or other flat surface. This arrangement allows the display to be rotated horizontally and vertically to the desired position.

1.04 SPECIFICATIONS

Table 1-1 lists the electrical and physical specifications for the 9601.

Table 1-1. 9601 Transmission Measurement Set Specifications

OSCILLATOR	
Fixed Frequencies:	404, 1004, and 2804 Hz
Variable Frequency Range:	50 Hz to 20.0 kHz
SF and 4000 Hz Skip:	Pressing the INCR FAST or DECR FAST button causes the oscillator to skip the 2450 to 2750 Hz and the 3980 to 4020 Hz bands. Pressing the INCR SLOW or DECR SLOW button will not skip these two bands.
Frequency Resolution:	±1 Hz from 50 to 4095 Hz ±5 Hz from 4.095 to 10.0 kHz ±10 Hz from 10.0 to 20.0 kHz
Frequency Accuracy:	±0.015%
Fixed Levels:	-13.0, -10.0, and 0.0 dBm
Variable Level Range:	-40.0 to +12.0 dBm (+10 dBm on 1200Ω)
Level Resolution:	±0.1 dB
Level Accuracy:	±0.1 dB
Level Variation with Frequency (150 ohms):	±1.5 dB from 50 to 300 Hz ±0.1 dB from 300 to 3400 Hz ±0.2 dB from 3.4 to 10.0 kHz ±0.5 dB from 10.0 to 20.0 kHz
Level Variation with Frequency (600, 900, or 1200 ohms):	±0.5 dB from 50 to 100 Hz ±0.2 dB from 100 to 300 Hz ±0.1 dB from 300 to 3400 Hz ±0.2 dB from 3.4 to 10.0 kHz ±0.5 dB from 10.0 to 20.0 kHz
Total Harmonic Distortion:	> 40 dB from 50 to 100 Hz > 50 dB from 100 to 4095 Hz > 45 dB from 4.095 to 20.0 kHz > 60 dB at 1004 Hz only
Output Impedances:	150, 600, 900, and 1200 ohms
Quiet Termination Noise:	< 10 dBrn

Table 1-1. 9601 Transmission Measurement Set Specifications (Continued)

LEVEL AND FREQUENCY MEASUREMENTS	
Level Accuracy from -52.0 to +12.0 dBm:	±0.1 dB at 1 kHz
Level Variation with Frequency:	±0.5 dB from 50 Hz to 100 Hz ±0.1 dB from 100 Hz to 10.0 kHz ±0.5 dB from 10.0 to 20.0 kHz
Level Display Resolution:	±0.1 dB
Detector:	Averaging
Frequency Range:	50 Hz to 20.0 kHz
Frequency Accuracy:	±1 Hz from 50 to 9999 Hz ±5 Hz from 10.0 to 20.0 kHz
Frequency Display Resolution:	±1 Hz from 50 to 9999 Hz ±10 Hz from 10.0 to 20.0 kHz
Level and Frequency Display Update Rate:	8 times per second
Frequency Response Range:	+64.0 to -64.0 dB
Bridging Impedance:	> 100 kΩ
Measuring Impedances:	150, 600, 900 and 1200 ohms
Selectable Level Protection Filter:	
Low Frequency (high pass):	> 25 dB loss at 20 Hz and 60 Hz; > 4 dB loss at 180 Hz
High Frequency (low pass):	10 kHz corner frequency, 12 dB/octave rolloff; >60 dB loss above 500 kHz (Meets Bell System PUB 41009 specifications)

NOISE MEASUREMENTS	
Noise Range (Metallic):	10 to 90 dBrn
Noise Accuracy (150 ohms):	±2 dB from 10 to 20 dBrn ±1 dB from 20 to 90 dBrn

Table 1-1. 9601 Transmission Measurement Set Specifications (Continued)

NOISE MEASUREMENTS (Continued)	
Noise Accuracy (600, 900, or 1200 ohms):	±1.5 dB from 10 to 20 dBrn ±1 dBm from 20 to 90 dBrn
Noise-to-Ground Range:	50 to 130 dBrn
Noise-to-Ground Accuracy (150 ohms):	±2.5 dB from 50 to 60 dBrn ±1.5 dB from 60 to 130 dBrn
Noise-to-Ground Accuracy (600, 900, or 1200 ohms):	±1.5 dB from 50 to 130 dBrn
Holding Tone Level:	±0 to -40 dBm
Notch Filter Attenuation:	> 50 dB from 995 to 1025 Hz
Noise Display Resolution:	±1 dB
Noise Display Update Rate:	2-1/2 times per second
Detector:	Quasi-RMS
Noise Filters:	All filters (C-Message, 3 kHz Flat, 15 kHz Flat, and Program) meet Bell System PUB 41009 specifications.
Measuring Impedances:	150, 600, 900, and 1200 ohms
Bridging Impedance	> 100 kΩ
RETURN LOSS MEASUREMENTS	
Measuring Range:	-10.0 dB return gain to +50.0 dB return loss
Return Loss Display Resolution:	±0.5 dB
Return Loss Accuracy:	±0.5 dB from -10.0 to +40.0 dB (two-wire) ±1.5 dB from +40.0 to +50.0 dB (two-wire) ±0.5 dB from -10.0 to +50.0 dB (four-wire)
Trans-Hybrid Loss Correction Range:	+30 to -20 dB in 0.1 dB steps
Impedances:	600 or 900 ohms (two-wire) 150, 600, 900, or 1200 ohms (four-wire)

Table 1-1. 9601 Transmission Measurement Set Specifications (Continued)

RETURN LOSS MEASUREMENTS (Continued)	
Internal Reference Network	600- or 900-ohm, ±0.1% resistor in series with a 2.16 µF, ±1% capacitor
Return Loss Transmit Level:	-10.0 dBm (fixed) on two-wire circuits and -10 or -26 dBm on four-wire circuits.
Noise-Weighting Filters:	All the following filters meet Bell System PUB 41009 specifications. When switching from one filter to another, the power level variation is less than ±0.1 dB. Echo Return Loss (ERL) - 560 to 1965 Hz Singing Return Loss Low (SRL LO) - 260 to 500 Hz Singing Return Loss High (SRL HI) - 2200 to 3400 Hz
Return Loss Display Update Rate:	2-1/2 times per second
GENERAL	
Return Loss at SEND and MEAS Jacks:	> 30 dB from 50 Hz to 20.0 kHz; 150-, 600-, 900-, or 1200-ohms input impedance
Longitudinal Balance at SEND and MEAS Jacks:	> 80 dB at 60 Hz > 60 dB at 540 Hz From 540 Hz to 20.0 kHz, longitudinal balance decreases at 6 dB/octave.
Maximum DC Blocking at SEND and MEAS Jacks:	±150V
Power Requirements: Voltage Amperage	 -42.5 to -52 Vdc; -48 Vdc nominal 500 mA nominal
Operating Temperature Range:	0 to 50° C
Storage Temperature Range:	-40 to +75° C
Physical Dimensions:	Height: 8.89 cm (3.5 inches) Width: 43.18 cm (17 inches)

SECTION II

INSTALLATION

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2. INTRODUCTION

This section contains information on inspecting the 9601, required installation tools and materials, and instructions to install and wire the 9601 and the 9496 Remote Displays.

2.01 UNPACKING AND INSPECTION

After unpacking the 9601, ensure that the front and rear panel controls, indicators, and switches are not damaged. If the unit is damaged:

(1) File a claim with the carrier.

(2) Keep the shipping container for inspection by the carrier.

(3) Contact the WILTRON Telecom Customer Service Department at (415) 969-6500.

2.02 REQUIRED TOOLS AND MATERIALS

The following tools and materials are needed to install a 9601:

(1) Standard installation tools, such as wrenches, screwdrivers, wire cutters, and wire strippers

(2) No. 12-24 screws

(3) Matching connector for rear panel connector P3 AMP Champ Type #552309-1 or equivalent for optional external office connections

(4) Digital Voltmeter or VOM with 0 to 100V dc measuring capability

2.03 EQUIPMENT MOUNTING

Mount the 9601 in a relay rack as follows:

(1) Slide the 9601 into its slot (2 rack spaces in the relay rack).

(2) Secure the panel with the four No. 12-24 screws.

(3) Refer to paragraph 2.04 for instructions to connect power to the 9601 and paragraph 2.05 for instructions to connect miscellaneous circuits to the 9601.

2.04 POWER AND GROUND CONNECTIONS

To connect the office battery, battery return, and frame ground to the 9601:

(1) Connect the -48V office battery to the -48V terminal of TB1 on the 9601 rear panel (Figure 2-1).

(2) Connect the office battery return to the GND terminal of TB1.

(3) If an ac converter is used instead of a -48V filtered battery, connect its -48V and ground outputs to the -48V and GND terminals of TB1.

(4) Connect the rack or frame ground to the FRAME terminal of TB1.

(5) If the 9601 is to be connected to a fuse panel, use a 1-1/3A fuse for the 9601 power feed.

(6) Wire the miscellaneous office connections; refer to paragraph 2.05.

(7) Perform the initial power checks in paragraph 2.07.

2.05 MISCELLANEOUS OPTIONAL OFFICE CONNECTIONS

See Figure 2-2 for miscellaneous external office connections to the 9601 rear panel connector P3. If external office connections are required, use an AMP Champ Type #552309-1 female connection (WILTRON part number 551-125) to make the above connections to P3. A 10-foot cable with a factory-wired connector that mates with P3 is available (WILTRON Model Q7413).

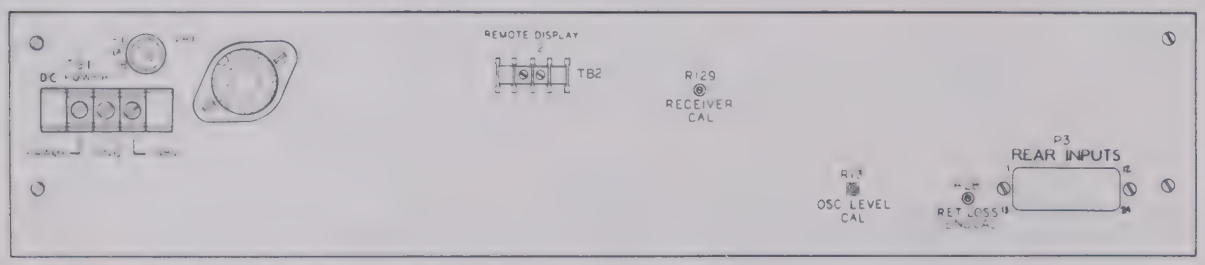
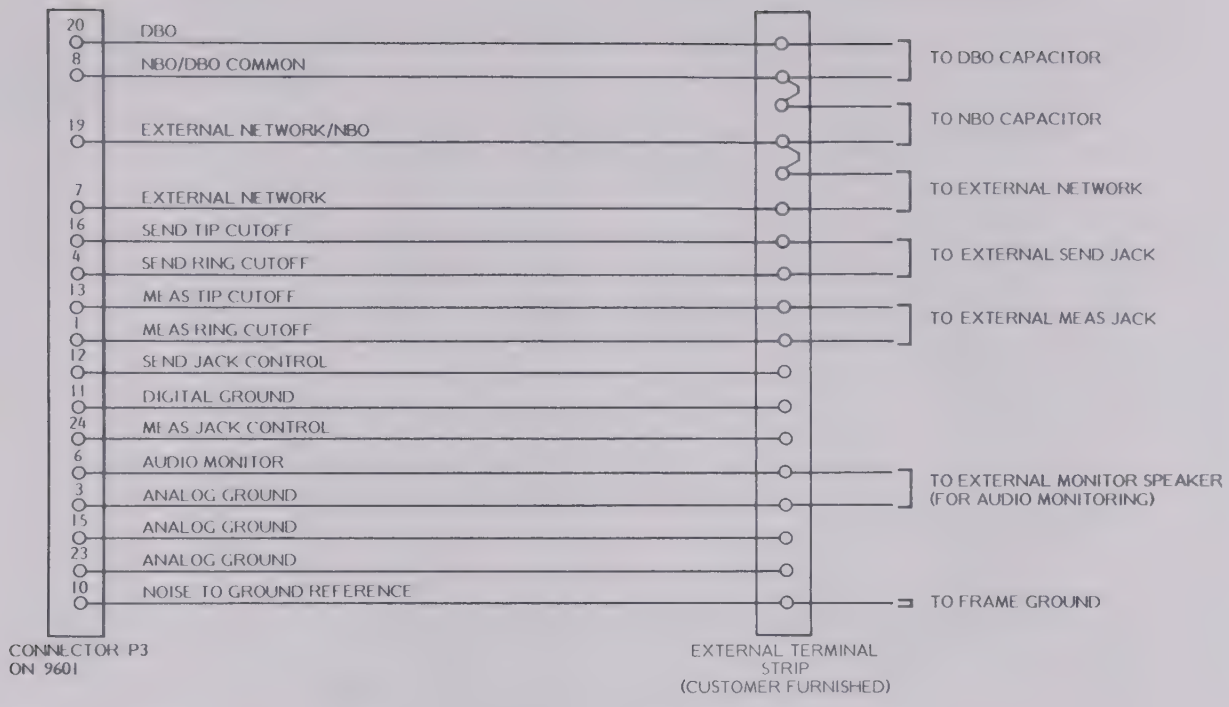


Figure 2-1. 9601 Transmission Measurement Set Rear Panel



NOTES: A. CONNECTOR P3 IS A MALE 24 PIN AMP CHAMP TYPE. THE MATING FEMALE CONNECTOR IS WILTRON #551-125 OR AMP #552309-1.
B. PINS 2, 5, 9, 14, 17, 18, 21, AND 22 ARE NOT USED.

Figure 2-2. Connector P3 Optional Miscellaneous Office Connections

2.06 9496 REMOTE DISPLAY CONNECTIONS

The 9496 Remote Displays (see Figure 2-3) can be connected to a 9601 Transmission Measurement Set either directly or by daisy-chaining. When directly connecting displays to a 9601, wire them in parallel, as shown in Figure 2-4. Refer to Table 2-1 for wiring instructions. When daisy-chaining the displays to the 9601, wire them as shown in Figure 2-5. Refer to Table 2-2 for wiring instructions.

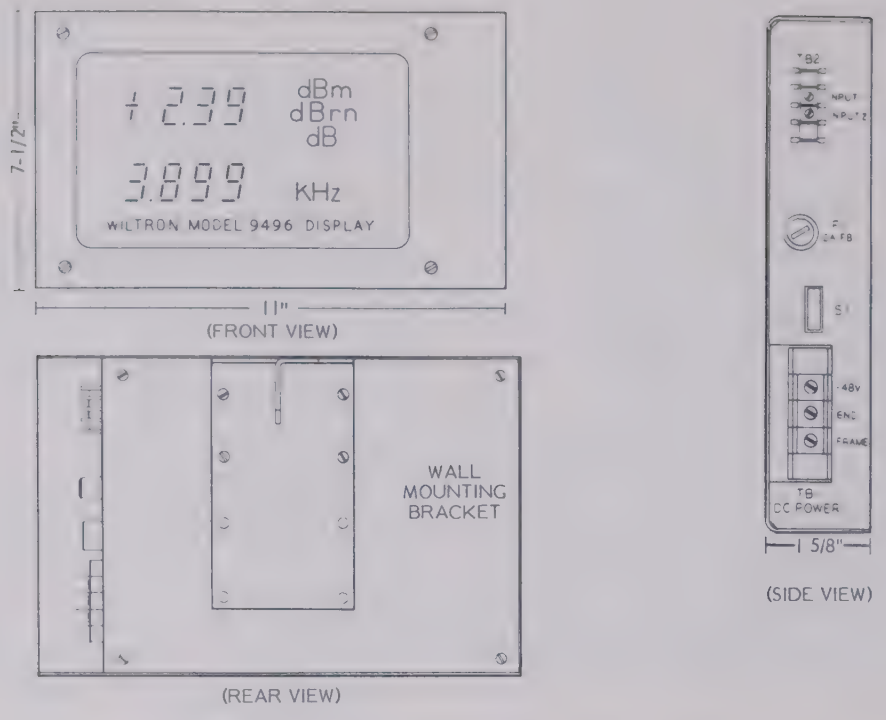
2.07 INITIAL POWER CHECKS

After connecting -48V office battery and ground to the 9601, proceed as follows:

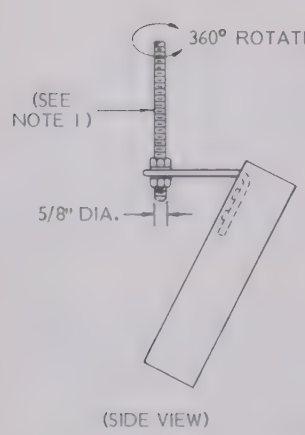
(1) On the 9601 rear panel, connect the DVM between the -48V and GND terminals of TB1.

(2) Ensure that the DVM reads the office battery voltage. If the DVM reading is incorrect, check the power cabling and the fuse in the fuse and distribution panel.

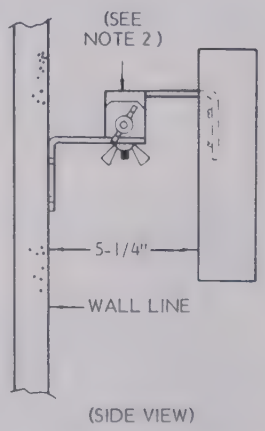
(3) Become familiar with the front panel controls by referring to Section III of this manual. Then, go to Section V and perform the verification checks.



(a) **Front and Rear Panels and Side Views**



(b) **Ceiling Mounting Arrangement**



(c) **Wall Mounting Arrangement**

NOTES:

1. WILTRON Kit No. 9463-2 contains four 0.625 I.D. x 1.062 O.D. washers, four 5/8" split lock washers, four 5/8" hex nuts, and one 3'0" 5/8" threaded rod. WILTRON kits can be ordered with different length ceiling rods.

2. WILTRON P/N 9463-1.

Figure 2-3. Model 9496 Remote Display

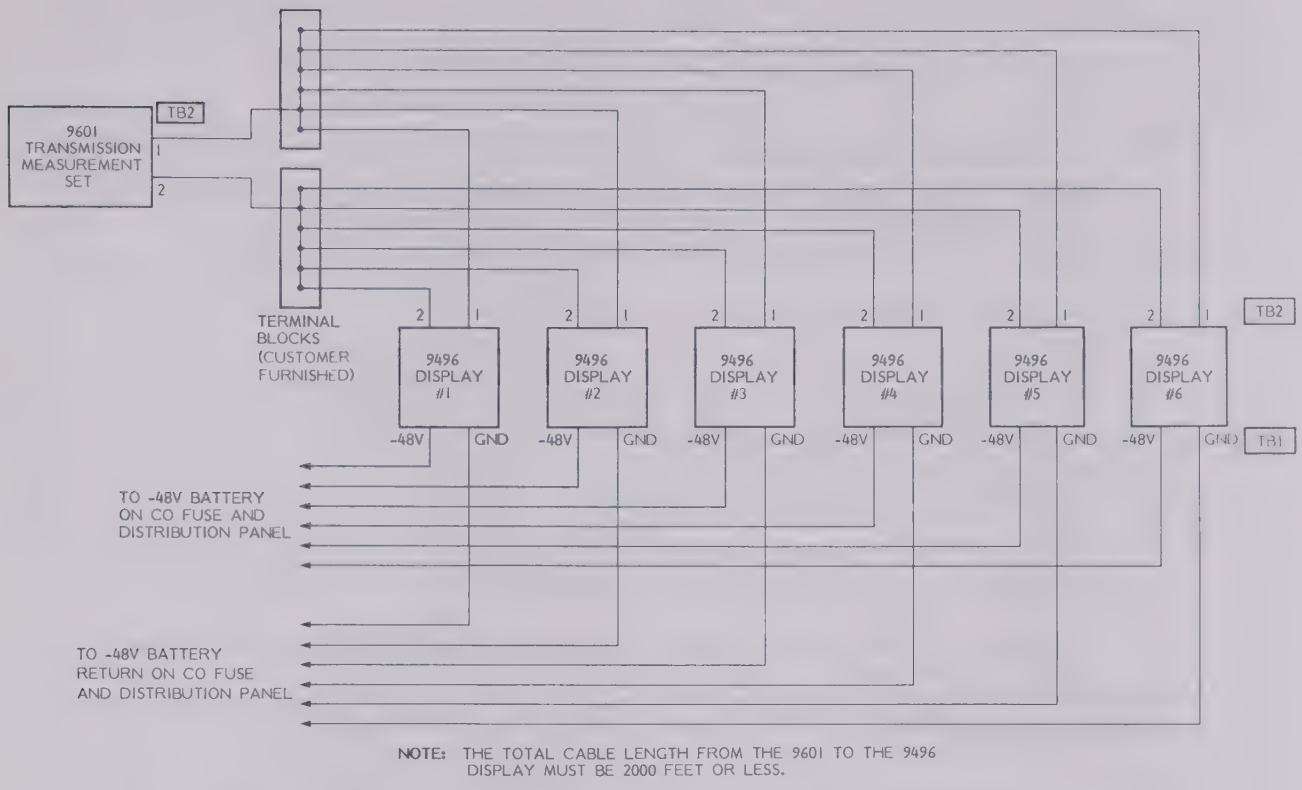


Figure 2-4. 9601-to-9496 Wiring Diagram (Direct Connection Method)

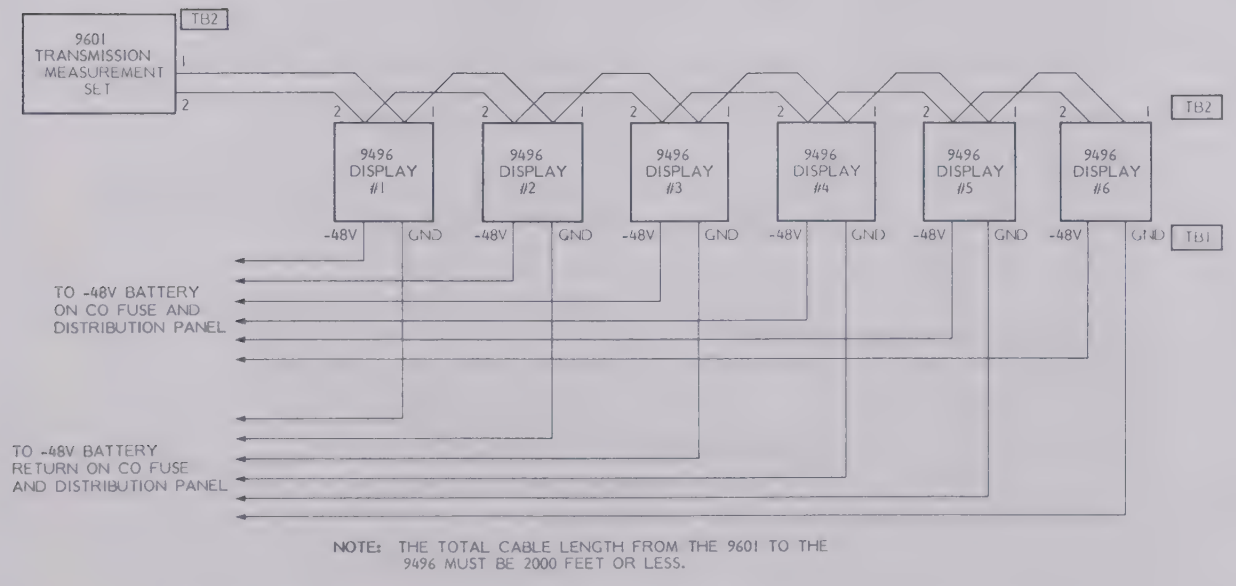


Figure 2-5. 9601-to-9496 Wiring Diagram (Daisy-Chaining Method)

Table 2-1. Directly Connecting 9496 Displays to the 9601 Transmission Measurement Set

STEP	PROCEDURE
	NOTE: When directly wiring two or more Displays to the 9601, two separate (customer-supplied) terminal blocks are required.
1	On the 9601 rear panel: a. Connect terminal 1 of TB2 to one terminal block. Use #24 AWG twisted-pair wire. b. Connect terminal 2 of TB2 to the other terminal block using the other wire in the twisted pair.
2	Mount the 9496 Display with the factory-supplied hardware at the desired location. **NOTE:** The maximum total cable length between the 9601 and all the 9496s is 2000 feet.
3	On the 9496 Display: a. Connect the INPUT 1 terminal of TB2 to the terminal block wired to terminal 1 of TB2 on the 9601 rear panel. Use #24 AWG twisted-pair wire. b. Connect the INPUT 2 terminal of TB2 to the terminal block wired to terminal 2 of TB2 on the 9601. **WARNING:** Do not apply -48V to the INPUT terminals of TB2. c. Verify that switch S1 is in the OFF (released) position. d. Connect the -48V terminal of TB1 to the c.o. fuse and distribution panel. Use #18 AWG or larger wire. Use a 1-1/3A fuse in the c.o. fuse panel. e. Connect the GND terminal of TB1 to the c.o. fuse and distribution panel. Use #18 AWG or larger wire. f. Press switch S1 to activate the 9496 Display.
4	To wire additional 9496 Displays directly to the 9601, repeat steps 2 and 3. The 9601 can power a maximum of six 9496 Remote Display Panels with up to 2000 total feet of cabling.

Table 2-2. Daisy-Chaining 9496 Displays to the 9601 Transmission Measurement Set

STEP	PROCEDURE
1	Mount each 9496 Display with the factory-supplied hardware at the desired location. **NOTE:** The maximum total cable length between the 9601 and all the 9496 Displays is 2000 feet.
2	On the first 9496 Display: a. Connect the INPUT 1 terminal of TB2 to the terminal 1 of TB2 on the 9601 rear panel. Use #24 AWG twisted-pair wire. b. Connect the INPUT 2 terminal of TB2 to the terminal 2 of TB2 on the 9601. **WARNING:** Do not apply -48V to the TB2 INPUT terminals. c. Verify that switch S1 is in the OFF (released) position. d. Connect the -48V terminal of TB1 to the c.o. fuse and distribution panel. Use #18 AWG or larger wire. Use a 1-1/3A fuse in the c.o. fuse panel. e. Connect the GND terminal of TB1 to the c.o. fuse and distribution panel. Use #18 AWG or larger wire.
3	On the second (and subsequent) 9496 Displays: a. Connect the INPUT 1 terminal of TB2 to the INPUT 1 terminal of TB2 on the first (or next lower numbered) 9496 Display. Use #24 AWG twisted-pair wire. See Figure 2-5. b. Connect the INPUT 2 terminal of TB2 to the INPUT 2 terminal of TB2 on the first (or next lower numbered) 9496 Display. See Figure 2-5. c. Verify that switch S1 is in the OFF (released) position. d. Connect the -48V terminal of TB1 to the c.o. fuse and distribution panel. Use #18 AWG or larger wire. Use a 1-1/3A fuse in the c.o. fuse panel. e. Connect the GND terminal of TB1 to the c.o. fuse and distribution panel. Use #18 AWG or larger wire.
4	To activate a 9496 Display, press switch S1. Repeat this step for each display.

SECTION III

FUNCTION OF CONTROLS, INDICATORS, AND CONNECTORS

3. INTRODUCTION

This section describes the functions of the front and rear panel controls, indicators, and connectors of the 9601 Transmission Measurement Set. Figure 3-1 shows the front panel controls and indicators and Table 3-1 describes them. Figure 3-2 shows the rear panel controls and connectors and Table 3-2 describes them.

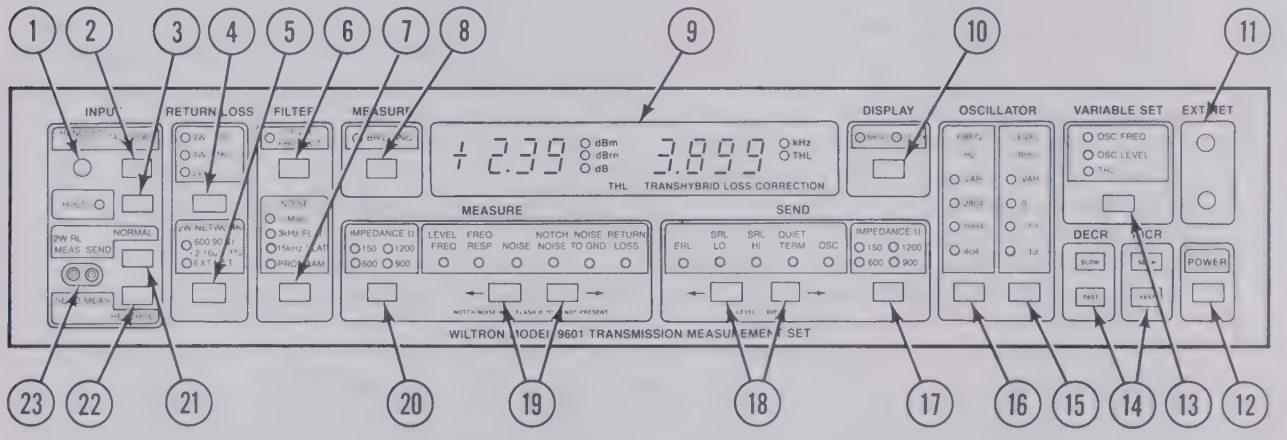


Figure 3-1. 9601 Transmission Measurement Set Front Panel Controls and Indicators

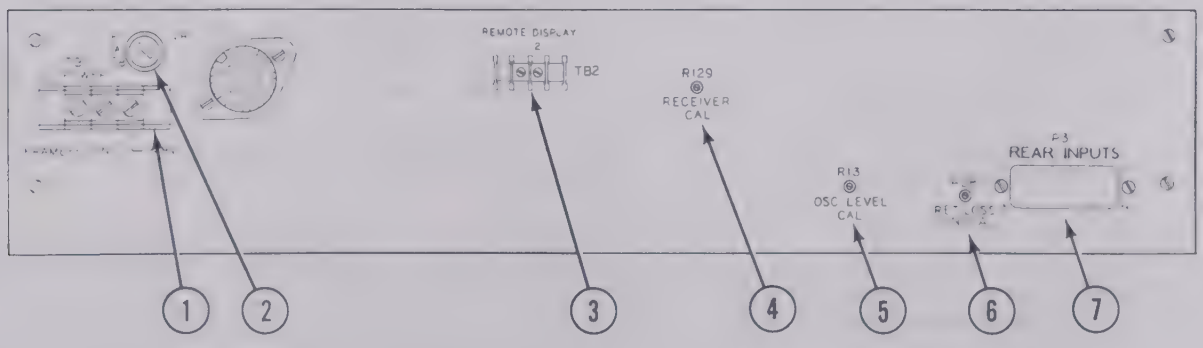


Figure 3-2. 9601 Rear Panel Controls and Connectors

Table 3-1. 9601 Front Panel Controls and Indicators

REF NO.	CONTROL/INDICATOR	DESCRIPTION
1	HANDSET 310 Jack	Connects a two-wire handset to the 9601.
2	TALK/DIAL Button	Connects the circuit under test when pressed to the handset jack.
3	HOLD Button	Activates the holding circuitry so that sending tests or measurements can be performed on the circuit under test without dropping the circuit.
	HOLD LED	Lights when the hold circuitry is activated.
4	RETURN LOSS Button	Selects the two-wire and four-wire return loss transmitter/receiver TLP's at the SEND and MEAS jacks (Ref No. 23). The four-wire TLP's are 0/0 and -16/+7.
	4W 0/0 LED	Lights when the four-wire 0/0 TLP is selected.
	4W -16/+7 LED	Lights when the four-wire -16/+7 TLP is selected.
	2W LED	Lights when the two-wire function is selected.
5	2W NETWORK Button	Selects either a 600/900 $\pm$0.1% ohm, 2.16 micro-farad, $\pm$1%, internal network or an external network for two-wire return loss measurements. Patch the external network to the EXT NET jacks (Ref No. 11). Or, the external network can be wired to the rear panel connector P3; refer to paragraph 2.05 for wiring instructions.
	600/900Ω +2.16 µF 0.1% LED	Lights when the internal reference network is selected.
	EXT NET LED	Lights when the external reference network is selected.
6	LEVEL PROTECT FILTER Button	Selects the level meter protection filter for level measurements if desired. (This filter meets Bell System PUB 41009 specifications.)

Table 3-1. 9601 Front Panel Controls and Indicators (Continued)

REF NO.	CONTROL/INDICATOR	DESCRIPTION
6 (cont.)	LEVEL PROTECT LED	Lights when the level meter protection filter is selected.
7	NOISE FILTER Button	Selects one of four filters for noise measurements: C-Message, 3 kHz Flat, 15 kHz Flat, and Program.
	C MSG LED	Lights when the C-Message filter is selected.
	3 kHz FLAT LED	Lights when the 3 kHz Flat filter is selected.
	15 kHz FLAT LED	Lights when the 15 kHz Flat filter is selected.
	PROGRAM LED	Lights when the Program filter is selected.
8	MEASURE Button	Selects either the bridging or terminated mode for level, noise, or frequency response measurements. In the terminated mode, the MEASURE IMPEDANCE Ω button (Ref No. 20) selects the input impedance of the selected measure mode.
	BRIDGING LED	Lights when the bridging measurement mode is selected.
9	LED Display	Indicates the selected send or measure mode values.
10	DISPLAY Button	Controls whether the LED display (Ref No. 9) indicates the oscillator signal sent (SEND LED lit) or the signal received (MEAS LED lit).
	SEND LED	Lights when the transmitted oscillator signal is indicated on the LED display.
	MEAS LED	Lights when the received signal is indicated on the LED display.
11	EXT NET Jacks	Connects an external reference network to the 9601. Pressing the 2W NETWORK button (Ref No. 5) until the EXT NET LED lights selects the external reference network mode.

Table 3-1. 9601 Front Panel Controls and Indicators (Continued)

REF NO.	CONTROL/INDICATOR	DESCRIPTION
12	POWER Button	Applies power to the 9601 when pressed.
13	VARIABLE SET Button	Enables the INCR and DECR buttons (Ref No. 14) to set either the oscillator variable frequency, oscillator variable level, or return loss THL correction value. To set the THL value, first press the VARIABLE SET button until the THL LED lights and then press the MEASURE → button (Ref No. 19) to light the RETURN LOSS LED. Select the 4W 0/0 or 4W +16/-7 RETURN LOSS mode (Ref No. 4), and then press the DISPLAY button (Ref No. 10) to light the MEAS LED. Next, press an INCR or DECR BUTTON (Ref No. 14) to set the THL value, which is shown on the display.
	OSC FREQ LED	Lights when the oscillator variable frequency mode is selected. When lit, the INCR and DECR buttons (Reference No. 14) will vary the oscillator frequency.
	OSC LEVEL LED	Lights when the oscillator variable level mode is selected. When lit, the INCR and DECR buttons (Reference No. 14) will vary the oscillator level.
	THL LED	Lights when the 4W Return Loss mode is selected. When lit, the INCR and DECR buttons (Reference No. 14) will change the THL value.
14	DECR SLOW, DECR FAST INCR SLOW, and INCR FAST Buttons	Set either the oscillator variable level, oscillator variable frequency, or return loss THL correction value. The VARIABLE SET button (Ref No. 13) selects the desired mode. Momentarily pressing any INCR or DECR button for less than 1/2 second causes the variable parameter to increase or decrease by the value shown in the PRESSED MOMEN-

Table 3-1. 9601 Front Panel Controls and Indicators (Continued)

<table>
<tr><th>REF NO.</th><th>CONTROL/INDICATOR</th><th>DESCRIPTION</th></tr>
<tr><td>14 (cont.)</td><td></td><td>TARILY columns in the table below each time the button is pressed

Pressing any INCR or DECR button for more than 1/2 second causes the variable parameter to increase or decrease by one step every 1/2 second as shown in the PRESSED CONTINUOUSLY columns in the table below.

<table>
<tr><th rowspan="2">PARAMETER</th><th colspan="2">DECR SLOW or INCR SLOW</th><th colspan="2">DECR FAST or INCR FAST</th></tr>
<tr><th>PRESSED MOMENTARILY</th><th>PRESSED CONTINUOUSLY</th><th>PRESSED MOMENTARILY</th><th>PRESSED CONTINUOUSLY</th></tr>
<tr><td>OSC FREQ</td><td>1 Hz</td><td>10 Hz</td><td>100 Hz</td><td>1000 Hz</td></tr>
<tr><td>OSC LEVEL</td><td>0.1 dBm</td><td>1.0 dBm</td><td>1.0 dBm</td><td>10.0 dBm</td></tr>
<tr><td>THL</td><td>0.1 dB</td><td>1.0 dB</td><td>1.0 dB</td><td>10.0 dB</td></tr>
</table>

Pressing and holding in an INCR or DECR button when a variable value is beyond its lower or upper limit value causes a "-" (underrange) or a "+" (overranged) to flash on the display. Pressing the FAST INCR or FAST DECR button in the oscillator variable frequency mode causes the oscillator to skip from 2450 to 2750 Hz (SF skip) and from 3980 to 4020 Hz so it does not send out a 2600 Hz or a 4000 Hz tone.</td></tr>
<tr><td>15</td><td>OSCILLATOR LEVEL Button</td><td>Selects the oscillator level in dBm. A variable level and three preset levels are provided: 0.0, -10.0 and -13.0 dBm. In the variable mode, press the VARIABLE SET button (Ref No. 13) to select the oscillator variable level mode, and then press an INCR or DECR button (REF No. 14) to set the desired oscillator level.

Applying power to the 9601 automatically selects the variable mode, 0.0 dBm.</td></tr>
<tr><td></td><td>-13 dBm LED</td><td>Lights when the -13.0 dBm level is selected.</td></tr>
<tr><td></td><td>-10 dBm LED</td><td>Lights when the -10.0 dBm level is selected.</td></tr>
</table>

Table 3-1. 9601 Front Panel Controls and Indicators (Continued)

REF NO.	CONTROL/INDICATOR	DESCRIPTION
15 (cont.)	0 dBm LED	Lights when the 0.0 dBm level is selected.
	VAR LED	Lights when the variable level mode is selected.
16	OSCILLATOR FREQ Button	Selects the oscillator frequency in Hz. A variable mode and three preset frequencies are provided: 404, 1004, and 2804 Hz. In the variable mode, press the VARIABLE SET button (Ref No. 13) to select the oscillator variable frequency mode, and then press an INCR or DECR button (Ref No. 14) to set the desired frequency.
	404 Hz LED	Lights when the 404 Hz frequency is selected
	1004 Hz LED	Lights when the 1004 Hz frequency is selected.
	2804 Hz LED	Lights when the 2804 Hz frequency is selected.
	VAR Hz LED	Lights when the variable frequency mode is selected.
17	SEND IMPEDANCE Ω Button	Selects one of four output impedances for the selected send mode: 150, 600, 900, or 1200 ohms. In the 2W return loss mode, only 600- or 900-ohm measurement impedances are enabled. Selecting a send impedance in the return loss mode also selects the matching measure impedance.
	150Ω LED	Lights when the 150-ohm output impedance is selected.
	600Ω LED	Lights when the 600-ohm output impedance is selected.
	900Ω LED	Lights when the 900-ohm output impedance is selected.
	1200Ω LED	Lights when the 1200-ohm output impedance is selected.
		In the oscillator mode, the oscillator output connects to the SEND jack (Ref No. 23). The OSCILLATOR LEVEL (Ref No. 15) OSCILLA-

Table 3-1. 9601 Front Panel Controls and Indicators (Continued)

REF NO.	CONTROL/INDICATOR	DESCRIPTION
17 (cont.)		TOR FREQUENCY (Ref No. 16), and SEND IMPEDANCE Ω (Ref No. 17) buttons set the oscillator level, frequency, and output impedance, respectively.
18	SEND ← and → Buttons	Selects one of five send modes: Oscillator, Quiet Termination, Singing Return Loss High (SRL HI), Singing Return Loss Low (SRL LO), and Echo Return Loss (ERL). Pressing the SEND → button once selects the next mode to the right of the currently selected mode. Pressing the SEND ← button once selects the next mode to the left of the currently selected mode. The display indicates the sending level in dBm and the frequency in kHz. In the Quiet Termination mode, the oscillator output turns off and the SEND IMPEDANCE Ω button (Ref No. 17) selects the terminating impedance at the SEND jack (Ref No. 23). In the ERL, SRL LO, or SRL HI mode, -10.0 dBm white noise (or -26 dBm white noise for four wire -16/+7 mode) is shaped by the associated ERL, SRL LO, or SRL HI filter, and goes to the circuit under test via the SEND jack (Ref No. 23). The display spells out the selected mode: "ERL", "SRL LO", or "SRL HI", when the DISPLAY SEND mode is selected (Reference No. 10). **NOTE:** When making Echo Return Loss or Singing Return Loss measurements through an echo suppressor, disable the echo suppressor by sending the appropriate tone using the SEND OSC function, and then press and hold in the SEND ← button until the desired ERL or SRL mode is selected. Applying power to the 9601 automatically selects the Oscillator mode.

Table 3-1. 9601 Front Panel Controls and Indicators (continued)

REF NO.	CONTROL/INDICATOR	DESCRIPTION
18 (cont.)	ERL LED	Lights when the ERL mode is selected.
	SRL LO LED	Lights when the SRL LO mode is selected.
	SRL HI LED	Lights when the SRL HI mode is selected.
	QUIET TERM	Lights when the QUIET TERM mode is selected.
	OSC LED	Lights when the Oscillator mode is selected.
19	MEASURE ← and → Buttons	Selects one of six measure modes: Level and frequency, frequency response, noise, noise-to-ground, and return loss. Pressing the MEASURE ← buttons once selects the next mode to the left of the currently selected mode. Pressing the MEASURE → button once selects the next mode to the right of the currently selected mode. In the frequency response and the level/frequency modes, the level/noise receiver measures the level and frequency of a tone from the circuit under test via the MEAS jack (Ref No. 23). Then, the display indicates the level in dBm and the frequency in kHz. In the frequency response mode, the frequency measured when the frequency response is initially selected becomes the 0 dB reference. In the noise, notched noise, and noise-to-ground modes, the level/noise receiver measures the noise from the circuit under test via the MEAS jack (Ref No. 23) and the selected noise filter (Ref No. 7). Then, the display indicates the noise in dBrn. In the return loss mode, first connect the circuit under test to the MEAS jack (Ref No. 23). For 2W return loss measurements, the return loss circuitry sends a -10.0 dBm white noise signal to the circuit under test and measures the return loss of the same circuit via the MEAS jack. For 4W return loss measurements, the return loss circuitry trans

Table 3-1. 9601 Front Panel Controls and Indicators (continued)

REF NO.	CONTROL/INDICATOR	DESCRIPTION
19 (cont.)		mits -10.0 dBm or -26.0 dBm of white noise under test patched to the SEND jack (Ref No. 23) and measures the return loss of the same circuit patched to the MEAS jack (Ref No. 23). Applying power to the 9601 automatically selects the Level and Frequency modes.
	LEVEL/FREQ LED	Lights when the level and frequency mode is selected.
	FREQ RESP LED	Lights when the frequency response mode is selected.
	NOISE LED	Lights when the noise mode is selected.
	NOTCH NOISE LED	Lights when the notched noise mode is selected. After this mode is selected, the LED flashes if a 1004 Hz holding tone is not present on the circuit under test.
	NOISE TO GND LED	Lights when the noise-to-ground mode is selected.
	RETURN LOSS LED	Lights when the return loss mode is selected.
20	MEASURE IMPEDANCE Ω Button	Selects one of four measurement impedances for the selected measure mode: 150, 600, 900, or 1200 ohms. In the 2W return loss mode, only 600- or 900-ohm input impedances are enabled. Selecting a measure impedance also selects the matching send impedance. Applying power to the 9601 automatically selects the 600-ohm input impedance.
	150Ω LED	Lights when the 150-ohm input impedance is selected.
	600Ω LED	Lights when the 600-ohm input impedance is selected.
	900Ω LED	Lights when the 900-ohm input impedance is selected.

Table 3-1. 9601 Front Panel Controls and Indicators (continued)

REF NO.	CONTROL/INDICATOR	DESCRIPTION
20 (cont.)	1200Ω LED	Lights when the 1200-ohm input impedance is selected.
21	NORMAL Button	Connects the 9601 measurement circuitry to the left-hand (MEAS) jack and the 9601 sending circuitry to the right-hand (SEND) jack..
22	REVERSE Button	Connects the 9601 measurement circuitry to the right-hand (MEAS) jack and the 9601 sending circuitry to the left-hand (SEND) jack. This allows send and measure function reversal without having to transfer patch cords and without dropping the circuit under test.
23	MEAS and SEND Bantam Jacks	Connect the circuit under test to the 9601 measure and send circuits, respectively, when the NORMAL button (Ref No. 21) is pressed. When the REVERSE button (Ref No. 22) is pressed, the cIrcuit under test is connected to the 9601 send and measure circuits, respectively. This allows send and measure function reversal without dropping the circuit under test and without having to transfer patch cords.

Table 3-2. 9601 Rear Panel Controls and Connectors

REF NO.	NAME	FUNCTION
1	TB1 Terminal Block	
	FRAME Terminal	Connects the 9601 to the office frame ground.
	GND Terminal	Connects the 9601 to the office battery return.
	-48V Terminal	Connects the 9601 to the office -48 Vdc battery supply or ac converter output.
2	F1 Fuse	Protects the 9601 internal power supply. 1A slow-blow fuse.
3	TB2 REMOTE DISPLAY Connector	
	Terminal 1	Connects to TB2 terminal 1 on the WILTRON 9496 Remote Display if required; refer to paragraph 2.06 for wiring instructions.
	Terminal 2	Connects to TB2 terminal 2 on the 9496 if required.
4	RECEIVER CAL R129 Adjustment	Calibrates the 9601 level/noise receiver at 0.0 dBm or to the TP2/TP3 level; refer to Table 6-3 for the calibration procedure.
5	OSC LEVEL CAL R13 Adjustment	Calibrates the 9601 oscillator at 0.0 dBm or to the TP2/TP3 level; refer to Table 6-3 for the calibration procedure.
6	RET LOSS SEND CAL R28 Adjustment	Calibrates the 9601 return loss transmitter; refer to Table 6-3 for the calibration procedure.
7	P3 REAR INPUTS Connector	Connects the miscellaneous office circuits to the 9601; refer to paragraph 2.05 for wiring instructions.

SECTION IV

OPERATING PROCEDURES

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4. INTRODUCTION

This section provides operating procedures for oscillator tests, level/noise and frequency measurements, return loss measurements, and dialing and talking on a 2-wire circuit with the WILTRON 9601 Transmission Measurement Set.

A simplified test configuration drawing and a front panel view of the 9601 accompanies each operating procedure. The simplified test configuration drawings show typical test setups using the 9601 and the front panel views highlight the 9601 controls, indicators, jacks, and displays used in each test.

4.01 9601 POWER-UP PROCEDURES

Use the following procedures to power up the 9601 Transmission Measurement Set:

(1) Visually inspect the 9601 to determine that all required external connections are complete (refer to Section II).

(2) Press the POWER button on the 9601 front panel. The 9601 voluntarily displays the software version, such as "01". It then momentarily displays the message "slf test". The LED display then indicates 0.0 dBm, 1.004 kHz output.

(3) If the 9601 fails to display the software version, the "slf test" message, and the oscillator output, carry out the performance verification procedures in Section V.

4.02 OSCILLATOR OPERATING PROCEDURES

Table 4-1 contains the operating procedures for connecting a test tone or quiet termination to a circuit under test.

4.03 LEVEL AND FREQUENCY MEASUREMENTS

A. 4-Wire Level and Frequency Measurements

Table 4-2 contains the operating procedures for level and frequency measurements on 4-wire circuits. The 1000 Hz loss (gain) measurement determines the point-to-point loss or gain of a 1000 Hz tone transmitted over a VF channel. In this test, as shown in Figure 4-1, an oscillator transmits a 1004 Hz tone from the sending office and the 9601 measures the level of the tone at the receiving office. The transmitted frequency is offset to 1004 Hz to prevent measurement errors when the measured frequency is a submultiple of T-carrier system sampling rates. The other two preset frequencies, 404 and 2804 Hz, have offsets of 4 Hz for the same reason. Also, the oscillator has an SF and 4000 Hz skip feature (refer to paragraph 1.01A).

Frequency measurements verify the frequency of the received tone.

B. Level and Frequency Measurements on 2-Wire Trunks

Table 4-3 contains the operating procedures for level and frequency measurements on 2-wire trunks. In this test, as shown in Figure 4-2, the circuit under test connects to a milliwatt (code 102) test tone via the switching equipment. The 9601 then measures the level and frequency of the milliwatt test tone.

C. Frequency Response (Attenuation Distortion) Measurements

Table 4-4 contains the operating procedures for frequency response measurements. In this test, as shown in Figure 4-3, the sending office transmits a tone over a circuit to the measuring office. At the receiving end, the 9601 stores the received level in dBm and displays it as the 0 dB reference. And then, as the sending office varies the oscillator frequency, the 9601 displays the received frequency in kHz and the level in dB relative to the reference level.

4.04 NOISE MEASUREMENTS

A. Noise Measurements on 4-Wire Circuits

Table 4-5 contains the procedures for noise measurements on 4-wire circuits. In this test, as shown in Figure 4-4, the sending office has a 600-ohm termination and the 9601 measures the noise over the circuit. Three noise measuring modes are provided: metallic noise, notched noise, and noise-to-ground.

In the metallic noise mode, the 9601 measures the noise across the tip and ring leads of the circuit under test. Terminated or bridged tests can be performed.

In the notched noise mode, the far-end office transmits a 1004 Hz test (holding) tone over a circuit. Then, at the receiving end, the 9601 selectively attenuates or notches the tone by at least 50 dB over the 995 to 1025 Hz range. This notched noise signal than passes through one of the selectable noise filters (C-message, 3kHz flat, 15 kHz flat, or program) prior to measurement.

In the noise-to-ground mode, the 9601 measures the noise from the tip/ring leads to the bay or frame ground. To determine the approximate noise level of the 60 Hz noise-to-ground on the circuit under test, first measure the noise level with the C-Message filter, and then with the 3 kHz Flat filter. The difference between these two noise readings is largely due to the 60 Hz noise on the circuit.

NOTE

Wire the 9601 noise-to-ground reference to the bay or frame ground; refer to paragraph 2.04 for wiring instructions.

In all the noise measuring modes, the 9601 has one of four selectable filters at its measuring input: C-Message, 3 kHz Flat, 15 kHz Flat, and Program.

The C-Message filter provides frequency weighting which evaluates the effects of noise encountered on typical Plain Old Telephone Service (POTS) and voice-grade data circuits.

The 3 Hz Flat filter is a 3 kHz low pass filter used to investigate the presence of low-frequency noise on voice-frequency circuits.

The 15 kHz Flat and Program filters are used for noise measurements on program channels that link broadcast studios to transmitter sites for example.

B. Noise Measurements on Trunks

Table 4-6 contains the operating procedures for noise measurements on trunks. In this test, as shown in Figure 4-5, the 9601 measures the noise on the trunk with a quiet termination applied via the switching equipment.

4.05 RETURN LOSS MEASUREMENTS

A. Return Loss Measurement Information

Return loss measurements on two-and four-wire circuits are made in three bands:

- ERL (Echo Return Loss) - 560 to 1965 Hz
- SRL LO (Singing Return Loss Low) - 260 to 500 Hz
- SRL HI (Singing Return Loss High) - 2200 to 3400 Hz

Singing generally occurs in the SRL LO or SRL HI bands, and the SRL band where singing is most likely to occur on a circuit and is called the "Singing Point" of the circuit.

Typical causes of low ERL and SRL LO readings:

- Defective or incorrectly strapped 4W terminating sets
- Impedance compensators improperly adjusted or cross-connected (inputs and outputs transposed)
- Incorrect or double termination at far end
- Repeat coils incorrectly wired or repeat coils with incorrect-value midpoint capacitors
- Excessive circuit noise

Typical causes of low SRL HI readings:

- Incorrect NBO or DBO capacitances
- Excessive circuit noise
- Office wiring is incorrect, or too long, or has side taps to distant equipment

B. Two-Wire Circuit

Table 4-7 contains the operating procedures for terminal-balance measurements on 2W circuits. Figure 4-6 shows the test setup. For 2W return loss measurements, the 9601 uses its internal hybrid instead of the office hybrid; as a result, the return loss measurements do not include the effects of the near-end office test hybrid and associated drop equipment cabling.

C. Through-Balance Measurements

Table 4-8 contains the operating procedures for through-balance measurements on 4W circuits. Figure 4-7 shows the test setup. Through balancing is the average of Echo Return Loss (ERL) and

Singing Return Loss (SRL) measurements made at all combinations of intertoll-through paths in Class 3 and higher telephone offices. As shown in Figure 4-7, these measurements involve only the office equipment and the four-wire-to-four-wire paths. The purpose of through balancing is to match the two-wire impedance of the four-wire terminating sets of the incoming trunks to the outgoing trunks on a uniform basis regardless of the connection path in a two-wire switching office.

D. Terminal Balance Measurements

Table 4-9 contains the operating procedures for terminal balance measurements on four-wire circuits. Figure 4-8 shows the test setup. Terminal balancing consists of matching the two-wire impedance of the four-wire terminating sets of intertoll trunks to the impedance of toll-connecting trunks. The purpose of terminal balancing is to obtain a transmission level performance for the toll office that will permit it to switch intertoll trunks at the network Via Net Loss (VNL) objectives.

E. Terminal Balance Measurements On Carrier Channels

Table 4-10 contains the operating procedures for terminal balance measurements on carrier channels. Figure 4-9 shows the test setup. In this test, as shown in Figure 4-9, the carrier-channel connects the near-end office to the far-end office. These return loss readings should be within the ERL and SRL terminal-balance tolerance for the circuit under test.

4.06 DIALING AND TALKING ON A TWO-WIRE CIRCUIT

Table 4-11 contains the operating procedure for dialing and talking on a two-wire circuit. Figure 4-10 shows the test setup. The two-wire circuit to be dialed is patched to the 9601 MEAS jack (Figure 4-10). After the telephone number of the circuit is dialed and the connection is made, the hold circuit is activated. Once the two-wire circuit is on hold, the sending or receiving tests described in this section can be performed.

Table 4-1. 9601 Oscillator Level, Frequency, Output Impedance and Quiet Termination Procedure

STEP	PROCEDURE
1	Press and hold the SEND → button until the OSC LED lights (see figure).
2	Press the DISPLAY button until the SEND LED lights. The display indicates the sending level in dBm and frequency in kHz.
3	Press and hold the SEND IMPEDANCE Ω button until the required impedance LED lights - 150, 600, 900, or 1200Ω.
4	Press and hold the OSCILLATOR FREQ button until the required frequency LED lights - 404, 1004, or 2804 Hz. For a frequency other than one of the three preset ones, press and hold the OSCILLATOR FREQ button until the VAR Hz LED lights, and then, go to step 5. If the VAR Hz mode is not selected, go the step 6 to select the required level.
5	Press and hold the VARIABLE SET button until the OSC FREQ LED lights. Then, press and hold an INCR SLOW, INCR FAST, DECR SLOW, or DECR FAST button until the display indicates the required frequency. **NOTE:** The oscillator skips from 2450 to 2750 Hz and from 3980 to 4020 Hz only when the INCR FAST or DECR FAST button is pressed and held.
6	Press and hold the OSCILLATOR LEVEL button until the required level LED lights -0, -10, or -13 dBm. For a level other than one of the three preset ones, press and hold the OSCILLATOR LEVEL button until the VAR dBm LED lights, and go to step 7. If the VAR dBm mode is not selected, go to step 8.
7	Press and hold the VARIABLE SET button until the OSC FREQ LED lights. Then, press and hold an INCR SLOW, INCR FAST, DECR SLOW, or DECR FAST button until the display indicates the required level.
8	Press the NORMAL button.
9	Patch the oscillator to the circuit under test via the SEND jack and begin testing. To connect a quiet termination to the circuit under test, press the SEND ← button until the QUIET TERM LED lights.

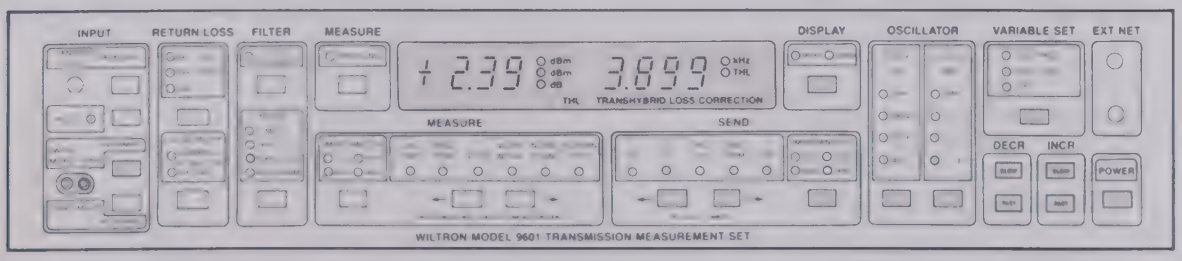
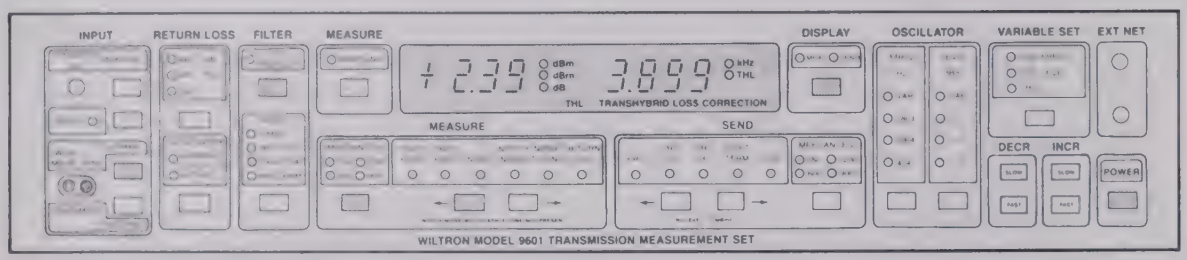


Table 4-2. 4-Wire Level and Frequency Measurements

STEP	PROCEDURE
1	Set up the equipment as shown in Figure 4-1.
2	Press the NORMAL button (see figure below).
3	Press and hold the MEASURE ← button until the LEVEL/FREQ LED lights.
4	Press the DISPLAY button until the MEAS LED lights.
5	Press and hold the MEASURE IMPEDANCE Ω button until the desired impedance LED lights.
6	Press the FILTER button once (if desired). LEVEL PROTECT LED lights when the level protection filter is selected.
7	On the display, observe the received level in dBm and the frequency in kHz. If the received level is above +12.0 dBm, the display indicates a (+) plus sign, if below -52.0 dBm, the display indicates a (-) minus sign. If the received frequency is below 20 Hz or above 20.0 kHz, the display indicates "Or" (out of range).



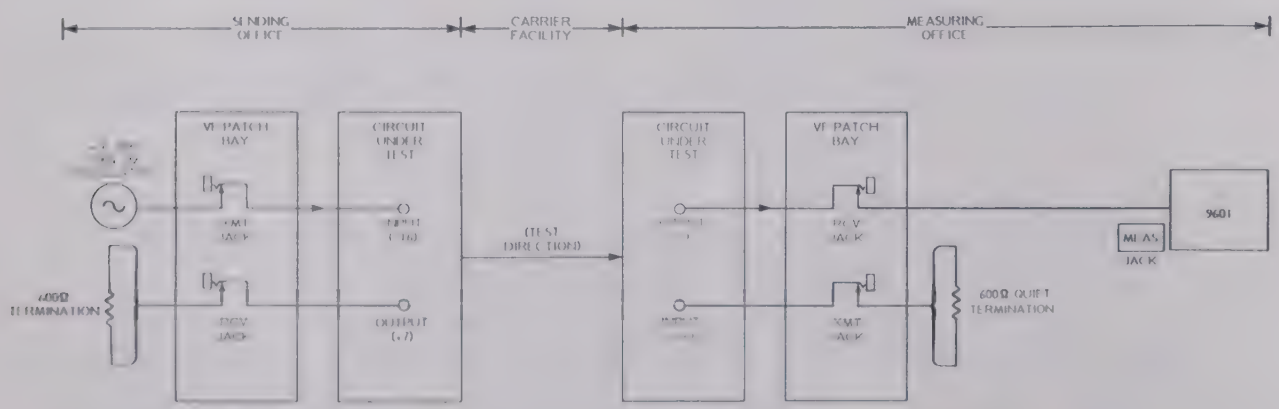
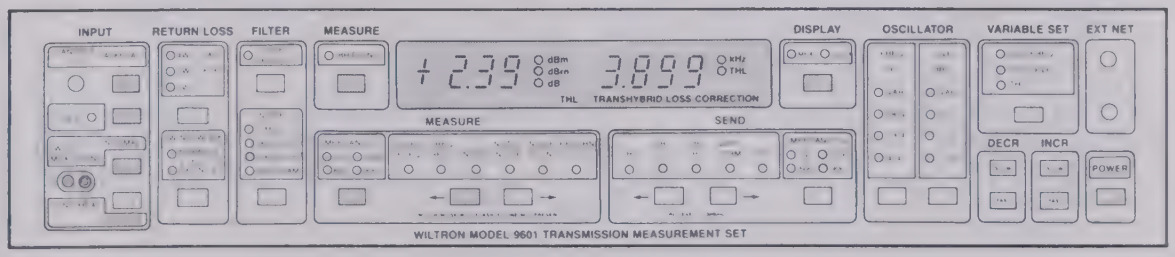


Figure 4-1. Typical Setup for Level/Frequency Measurements on 4-Wire Circuits

Table 4-3. Level and Frequency Measurements on 2-Wire Trunks

STEP	PROCEDURE
1	Set up the equipment to a trunk selected for testing as shown in Figure 4-2.
2	Press the NORMAL button (see figure).
3	Press the DISPLAY button until the MEAS LED lights.
4	Press and hold the MEASURE IMPEDANCE Ω button until the required impedance LED lights - normally 600 or 900 ohms.
5	If the bridging mode is desired, press the MEASURE button until the BRIDGING LED lights.
6	Connect a handset to the HANDSET 310 jack.
7	Press the TALK DIAL button.
8	On the handset, dial the number for the office milliwatt trunk (code 102 trunk).
9	Once the trunk connection is made, press the HOLD button until HOLD LED lights, and then, release the TALK DIAL button.
10	On the display, observe the received level in dBm and the frequency in kHz. If the received level is above +12.0 dBm, the display indicates a + (plus) sign; if below -52.0 dBm, the display indicates a - (minus) sign. If the received frequency is below 20 Hz or above 20.0 kHz, the display indicates "Or" (out of range).



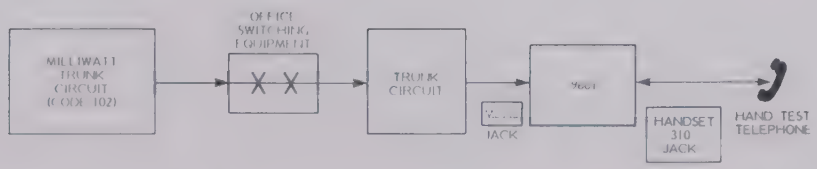
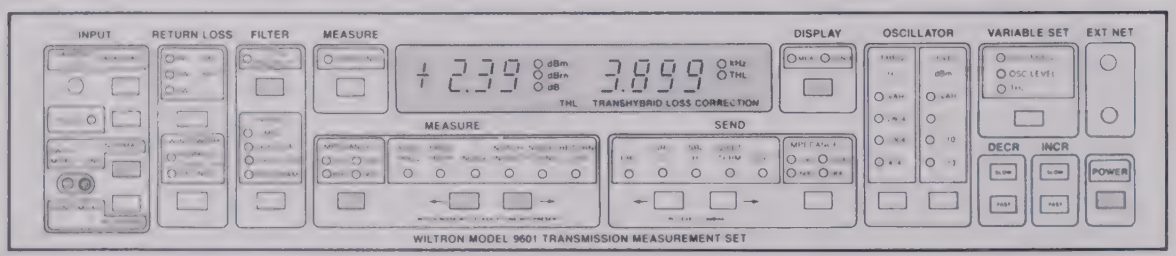


Figure 4-2. Typical Setup for Level/Frequency Measurements on 2-Wire Trunks

Table 4-4. Frequency Response Measurements

STEP	PROCEDURE
1	To dial and talk on a 2-wire circuit, refer to Table 4-11.
2	Set up the equipment as shown in Figure 4-3.
3	Press the NORMAL button (see figure below).
4	Press and hold the MEASURE ← button until the LEVEL/FREQ LED lights (see figure below).
5	Press the DISPLAY button until the MEAS LED lights.
6	Press the FILTER button once (if desired). LEVEL PROTECT LED lights when the level protection filter is selected.
7	On the display, observe the received level in dBm and frequency in kHz. If received level is above +12.0 dBm, the display indicates a (+) plus sign; if below -52.0 dBm, the display indicates a (-) minus sign. If the received frequency is below 20 Hz or above 20.0 kHz, the display indicates "Or" (out of range).
8	Press the MEASURE → button once. The FREQ RESP LED lights to indicate the selected mode. The 9601 stores the received level as the reference level and the display indicates 0.0 dB and the received frequency.
9	Request the far end to change test frequency in steps, then, as the sending frequency varies, the display indicates the level in dB relative to the reference level in step 8 and the received frequency in kHz.



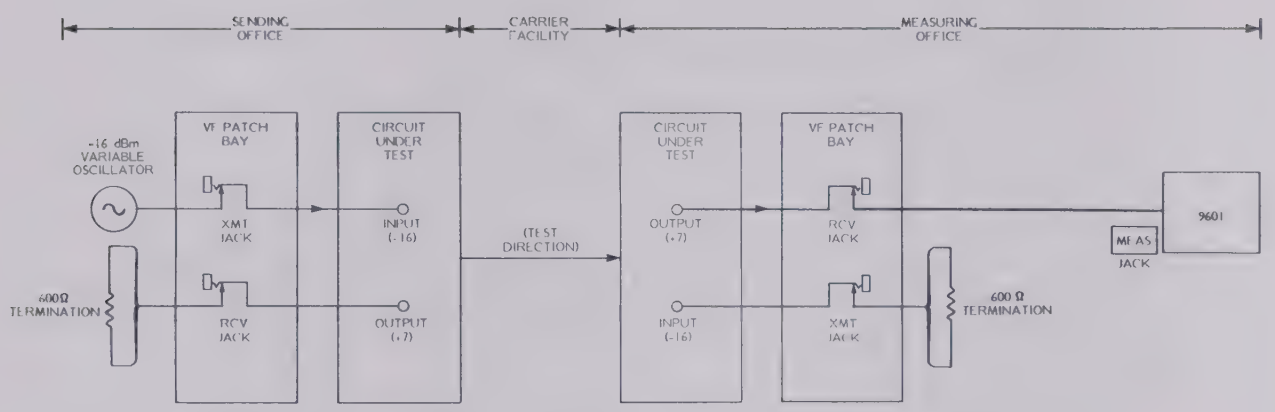
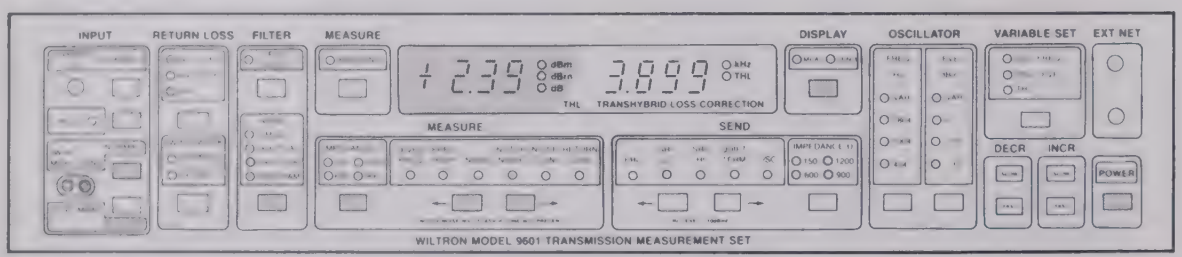


Figure 4-3. Typical Setup for Frequency Response Measurements

Table 4-5. 4-Wire Noise Measurements

STEP	PROCEDURE
1	Set up the equipment as shown in Figure 4-4.
2	Press the NORMAL button (see figure).
3	Press the MEASURE ← or → button to select the desired noise mode: Noise (metallic), notched noise, or noise-to-ground. The lighted LED indicates the selected mode: NOISE, NOTCH NOISE, or NOISE-TO-GROUND. **NOTE:** If notch noise mode is selected and a 1004 Hz holding tone is not present, the NOTCH NOISE LED flashes.
4	Press the DISPLAY button until the MEAS LED lights.
5	Press and hold the MEASURE IMPEDANCE Ω button until the desired impedance LED lights.
6	Press and hold the NOISE button to select the desired noise filter: C-Message, 3 kHz Flat, 15 kHz Flat, or Program. The lighted LED indicates the selected mode: C-MSG, 3 kHz FLAT, 15 kHz FLAT, or PROGRAM.
7	On the display, observe the noise reading in dBrn. If the noise measurement exceeds 90 dBrn (metallic) or 130 dBrn (noise-to-ground), the display indicates a + (plus) sign. If the noise is less than 10 dBrn (metallic) or 50 dBrn (noise-to-ground), the display indicates a -(minus) sign. The frequency display is blank during noise measurements.



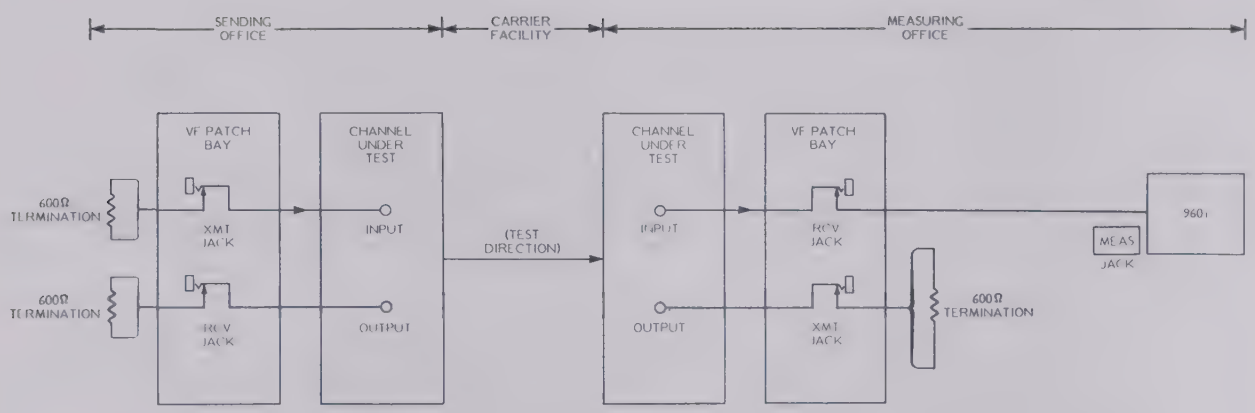
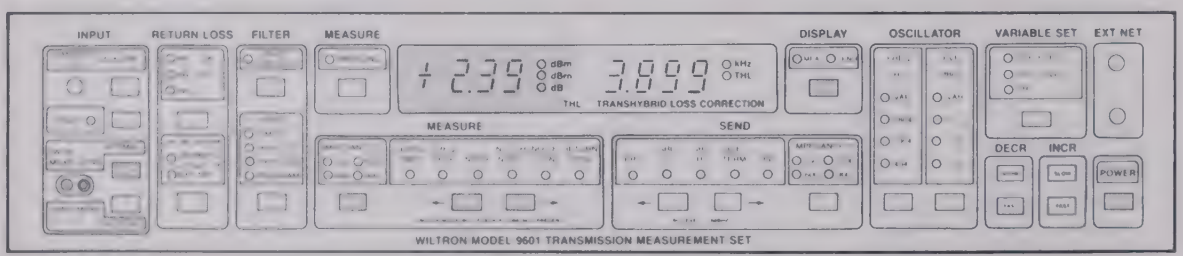


Figure 4-4. Typical Setup for 4W Noise Measurements

Table 4-6. Noise Measurement on Trunks

STEP	PROCEDURE
1	To dial and talk on a 2-wire circuit, refer to Table 4-11.
2	Press the NORMAL button (see figure below).
3	Press the MEASURE ← or → button to select the desired noise mode: Noise, notched noise, or noise-to-ground. The lighted LED indicates the selected mode: NOISE, NOTCH NOISE, or NOISE-TO-GROUND. **NOTE:** If notch noise mode is selected and a 1004 Hz holding tone is not present, the NOTCH NOISE LED flashes.
4	Press the DISPLAY button until the MEAS LED lights.
5	Press and hold the MEASURE IMPEDANCE Ω button until the desired impedance LED lights.
6	Press and hold the NOISE button to select the desired noise filter: C-Message, 3 kHz Flat, 15 kHz Flat, or Program. The lighted LED indicates the selected mode: C-MSG, 3 kHz FLAT, 15 kHz FLAT, or PROGRAM.
7	On the display, observe the noise reading in dBrn. If the noise measurement exceeds 90 dBrn (metallic) or 130 dBrn (noise-to-ground), the display indicates a + (plus) sign. If noise is less than 10 dBrn (metallic) or 50 dBrn (noise-to-ground), the display indicates a - (minus) sign. The frequency display is blank during noise measurements.



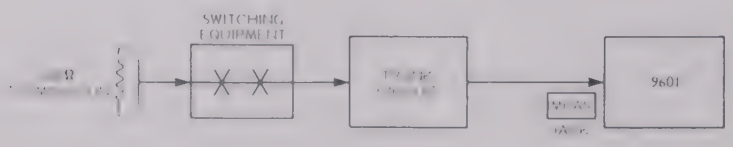


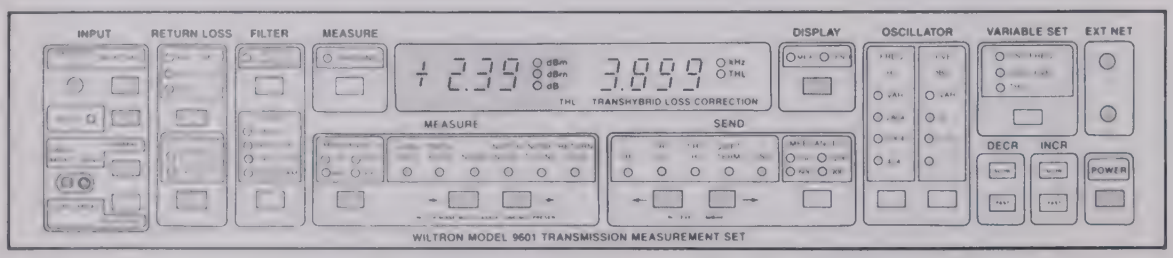
Figure 4-5. Typical Setup for Noise Measurements on Trunks

Table 4-7. 2-Wire Terminal-Balance (Echo Return Loss and Singing Return Loss) Measurements

STEP	PROCEDURE
1	Set up the equipment as shown in Figure 4-6.
2	To dial and talk on a 2-wire circuit, refer to Table 4-11.
3	Press the NORMAL button (see figure). **NOTE:** Telco practices may require the use of NBO and DBO capacitors; if so, refer to paragraph 2.05 for wiring instructions. If a DBO capacitor is required, use a decade capacitor box, such as the WILTRON Model 9315 Decade Capacitor.
4	Press the MEASURE → button until the RETURN LOSS LED lights (see figure).
5	Press the RETURN LOSS button until the 2W LED lights.
6	Press and hold the MEASURE IMPEDANCE Ω button until required impedance LED lights (600 or 900Ω). **NOTE:** If an external reference network is used, wire it to the EXT NET jacks.
7	Press the 2W NETWORK button until the 600/900Ω 2.16 μF 1% LED lights to select the internal reference network. If an external network is used instead of the internal one, press the 2W NETWORK button until the EXT NET LED lights.
8	If the terminal-balance (ERL and SRL) measurements are to be made through an echo suppressor, complete this step; if not, continue with step 9. a. Press the DISPLAY button until the SEND LED lights. b. Press the SEND → button until the SEND OSC LED lights. c. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights. d. Press the OSCILLATOR FREQ button until the VAR LED lights. e. Press the VARIABLE SET button until the OSC FREQ LED lights. f. Press the INCR and/or DECR buttons until the 9601 display shows the echo suppressor disabling tone (usually 2.180 kHz). This disables the echo suppressor. g. Press and hold in the SEND ← button until the SEND ERL LED lights. **NOTE:** When performing the rest of these procedures, do not press the SEND → button until the QUIET TERM LED lights or the echo suppressor will be enabled and further ERL and SRL measurements will not be possible.

Table 4-7. 2-Wire Terminal-Balance (Echo Return Loss and Singing Return Loss) Measurement (Continued)

STEP	PROCEDURE
8 (cont.)	h. Press the DISPLAY button until the MEAS LED lights. i. Continue with step 11.
9	Press the DISPLAY button until the MEAS LED lights.
10	Press the SEND ← button until the ERL LED lights.
11	Refer to Table 4-11 to establish a connection to a balance termination (600/900Ω + 2.16 µF) through a reference outgoing trunk and switching equipment and the toll-connecting trunk under test.
12	Observe the display on the Echo Return Loss (ERL) reading in dB.
13	Press the SEND → button once. The SRL LO LED lights to indicate the selected mode. The display now indicates the SRL LO reading.
14	Press the SEND → button once. The SRL HI LED lights to indicate the selected mode. The display now indicates the SRL HI reading.
15	Compare the SRL LO and SRL HI readings in steps 13 and 14. The lower reading is the Singing Point of the circuit.
16	To correct return loss problems, refer to local plant practices. **NOTE:** Circuit noise can cause incorrect return loss readings. Measure the circuit noise by selecting the Noise mode and the C-Message filter. If the noise is not to affect the return loss measurement, it should be at least 10 dB in level below the return loss signal.



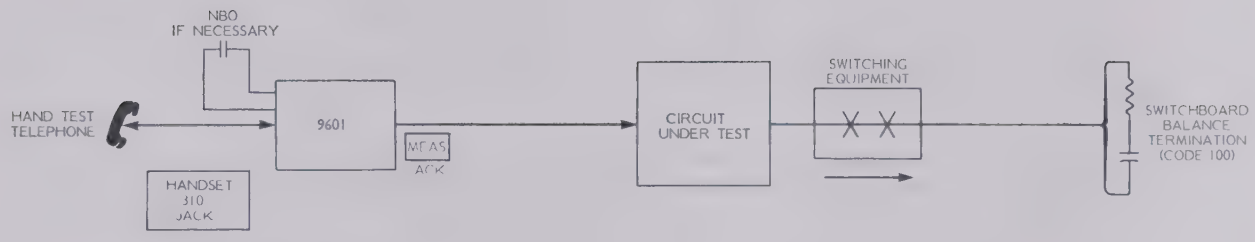


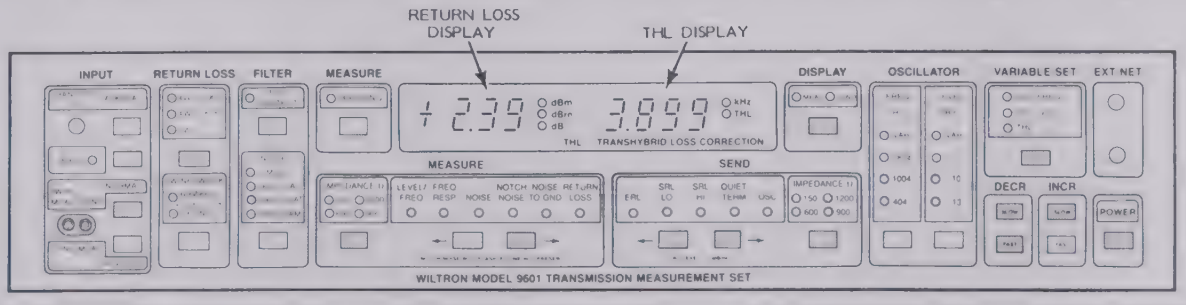
Figure 4-6. Return Loss Test Setup for 2-Wire Circuits

Table 4-8. 4-Wire Through-Balance Return Loss Measurements

STEP	PROCEDURE
1	Set up the equipment as shown in Figure 4-7.
2	Press the NORMAL button (see figure below).
3	If the through-balance (ERL and SRL) measurements are to be made through an echo suppressor, complete this step; if not, continue with step 4. a. Press the DISPLAY button until the SEND LED lights. b. Press the SEND → button until the SEND OSC LED lights. c. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights. d. Press the OSCILLATOR FREQ button until the VAR LED lights. e. Press the VARIABLE SET button until the OSC FREQ LED lights. f. Press the INCR and/or DECR buttons until the 9601 display shows the echo suppressor disabling tone (usually 2.180 kHz). This disables the echo suppressor. g. Press and hold in the SEND ← button until the SEND ERL LED lights. **NOTE:** When performing the rest of these procedures, do not press SEND → button until the QUIET TERM LED lights or the echo suppressor will be enabled and further ERL and SRL measurements will not be possible. h. Continue with step 5.
4	Press the SEND ← button until the ERL LED lights.
5	Press the SEND IMPEDANCE Ω button until the 600Ω LED lights.
6	Press the MEASURE → button until the RETURN LOSS LED lights.
7	Press the MEASURE IMPEDANCE Ω button until the 600Ω lights.
8	Press the RETURN LOSS button until the 4W 0/0 lights.
9	Press the DISPLAY button until the MEAS LED lights.
10	Use the office test hybrid and the drop equipment to drop-dial the through office to an intertoll trunk selected for testing (Figure 4-7).
11	Dial the code for a test short or open or apply an open or short circuit condition on the 2-wire side of the office test hybrid.
12	Press the VARIABLE set button until the THL LED lights.

Table 4-8. 4-Wire Through-Balance Return Loss Measurements (Continued)

STEP	PROCEDURE
13	Press an INCR or DECR button to increase or decrease the THL correction value until the left side of the display indicates a return loss reading of 0.0 dB.
14	If an open or short circuit condition was applied to the 2-wire side of the office test hybrid, remove the open or short condition.
15	Dial the office code for a balance termination.
16	The display now indicates the Echo Return Loss (ERL) reading in dB for the intertoll trunk connection.
17	Press the SEND → button once. The SRL LO LED lights to indicate the selected mode.
18	Observe on the display the SRL LO reading in dB. Note the reading.
19	Press the SEND → button once. The SRL HI LED lights to indicated the selected mode.
20	Observe on the display the SRL HI reading in dB. Note the reading.
21	Compare the readings in steps 18 and 20. The lower reading is the Singing Point of the connection under test.
22	Repeat steps 1 through 21 for all combinations of the intertoll-through paths in the office to determine the average office balance readings.
23	To correct return loss problems, refer to the local plant practices.



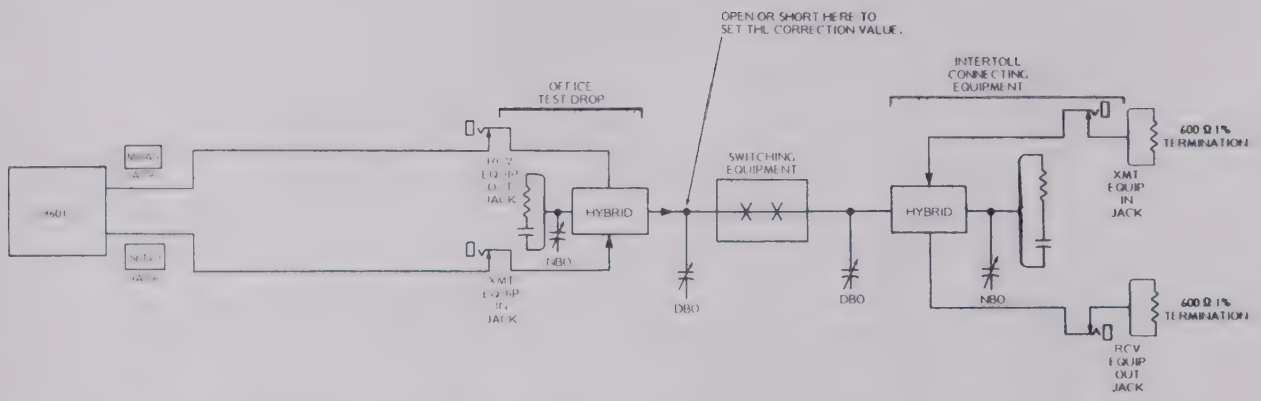


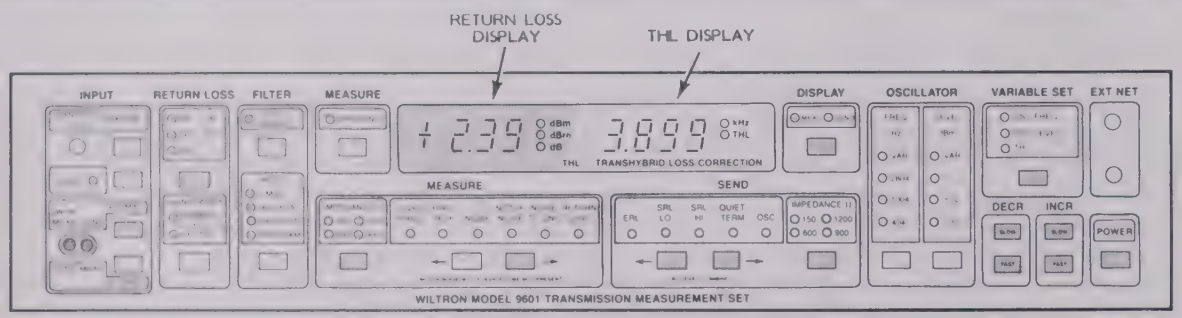
Figure 4-7. Typical Setup for 4W Through-Balance Return Loss Measurements

Table 4-9. 4-Wire Terminal Balance Measurements

STEP	PROCEDURE
1	Set up the equipment as shown in Figure 4-8.
2	Press the NORMAL button (see figure).
3	If the terminal balance measurements are to be made through an echo suppressor, complete this step; if not, continue with step 4. a. Press the DISPLAY button until the SEND LED lights. b. Press the SEND → button until the SEND OSC LED lights. c. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights. d. Press the OSCILLATOR FREQ button until the VAR LED lights. e. Press the VARIABLE SET button until the OSC FREQ LED lights. f. Press the INCR and/or DECR buttons until the 9601 display shows the echo suppressor disabling tone (usually 2.180 kHz). This disables the echo suppressor. g. Press and hold in the SEND ← button until the SEND ERL LED lights. **NOTE:** When performing the rest of these procedures, do not press the SEND → button until the QUIET TERM LED lights or the echo suppressor will be enabled and further ERL and SRL measurements will not be possible. h. Continue with step 5.
4	Press the SEND ← button until the ERL LED lights.
5	Press the SEND IMPEDANCE Ω button until the 600Ω LED lights.
6	Press the MEASURE → button until the RET LOSS LED lights.
7	Press the MEASURE IMPEDANCE Ω button until the 600Ω LED lights.
8	Press the DISPLAY button until the MEAS LED lights.
9	Press the RETURN LOSS button until the 4W 0/0 LED lights.
10	Dial the office code for a test short or open.
11	Press the VARIABLE SET button until the THL LED lights.
12	Press an INCR or DECR button to increase or decrease the THL correction value so that the left side of the display indicates a return loss reading of 0.0 dB.
13	Dial the office code for a balance termination.

Table 4-9. 4-Wire Terminal Balance Measurements (Continued)

STEP	PROCEDURE
14	Observe on the display the Echo Return Loss (ERL) reading in dB for the toll-connecting trunk under test.
15	Press the SEND → button once. The SRL LO LED lights to indicate the selected mode.
16	Observe on the display the SRL LO reading in dB. Note the reading.
17	Press SEND → button once. SRL HI LED lights to indicate the selected mode.
18	Observe on the display the SRL HI reading in dB. Note the reading.
19	Compare the readings in steps 16 and 18. The lower reading in the Singing Point of the toll-connecting trunk under test.
20	Repeat steps 1 through 19 for all the remaining toll-connecting trunk path combinations in the office.
21	To correct return loss problems, refer to local plant practices.



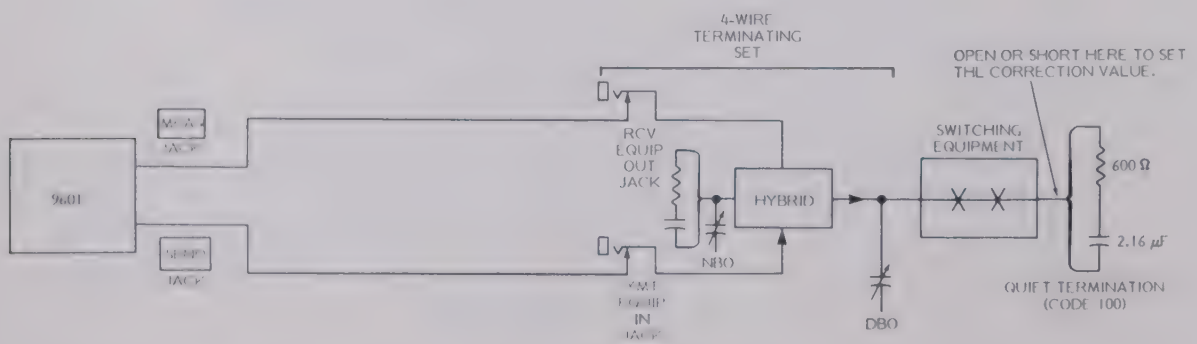


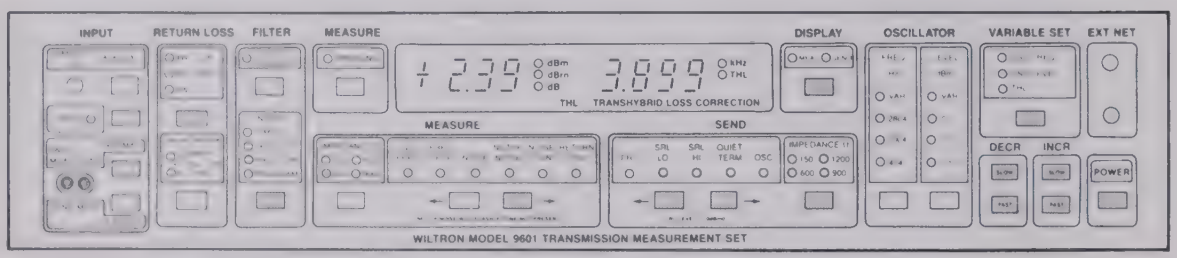
Figure 4-8. Typical Setup for 4W Terminal Balance Return Loss Measurements

Table 4-10. Terminal-Balance Measurements on Carrier Channels

STEP	PROCEDURE
1	Set up the equipment as shown in Figure 4-9.
2	Press the NORMAL button (see figure below).
3	If the terminal balance measurements are to be made through an echo suppressor, complete this step; if not, continue with step 4. a. Press the DISPLAY button until the SEND LED lights. b. Press the SEND → button until the SEND OSC LED lights. c. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights. d. Press the OSCILLATOR FREQ button until the VAR LED lights. e. Press the VARIABLE SET button until the OSC FREQ LED lights. f. Press the INCR and/or DECR buttons until the 9601 display shows the echo suppressor disabling tone (usually 2.180 kHz). This disables the echo suppressor. g. Press and hold in the SEND ← button until the SEND ERL LED lights. **NOTE:** When performing the rest of these procedures, do not press the SEND → button until the QUIET TERM LED lights or the echo suppressor will be enabled and further ERL and SRL measurements will not be possible. h. Continue with step 5.
4	Use the office test hybrid and line equipment to line-dial the carrier under test at the near office for a balance termination at the far office.
5	Press the RETURN LOSS button until the 4W -16/+7 LED lights.
6	Press the SEND ← button until the ERL LED lights.
7	Press the SEND IMPEDANCE Ω button until the 600Ω LED lights.
8	Press the MEASURE → button until the RETURN LOSS LED lights.
9	Press the MEASURE IMPEDANCE Ω button until the 600Ω LED lights.
10	Press the DISPLAY button until the MEAS LED lights.
11	Dial the office code for a test short or open in the far end office.
12	Press the VARIABLE SET button until the THL LED lights.
13	Press an INCR or DECR button in increase or decrease the THL correction value so the display indicates a return loss reading of 0.0 dB.

Table 4-10. Terminal-Balance Measurements on Carrier Channels (Continued)

STEP	PROCEDURE
	NOTE: The THL correction value is set to produce a return loss reading of 0.0 dB because the 9601 is applying a fixed 23 dB loss to compensate for carrier gain.
14	Dial the office code for a balance termination in the far end office.
15	Observe on the display the Echo Return Loss (ERL) reading in dB for the circuit under test.
16	Press the SEND → button once. The SRL LO LED lights to indicate the selected mode.
17	Observe the SRL LO reading on the display. Note the reading.
18	Press the SEND → button once. The SRL HI LED lights to indicate the selected mode.
19	On the display, observe the SRL HI reading. Note the reading.
20	Compare the readings in steps 17 and 19. The lower reading is the Singing Point of the circuit.
21	Repeat steps 1 through 20 for all remaining carrier channels in the office.



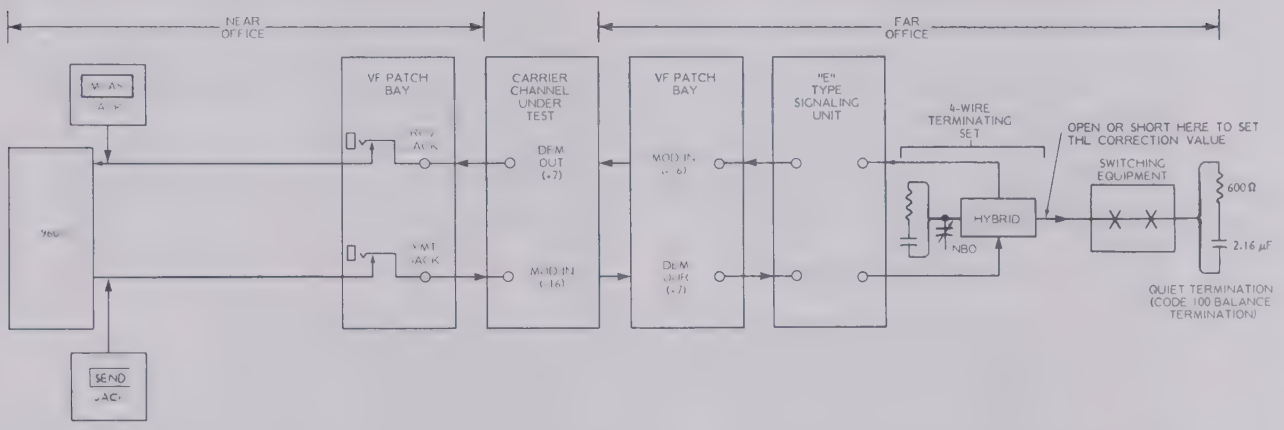
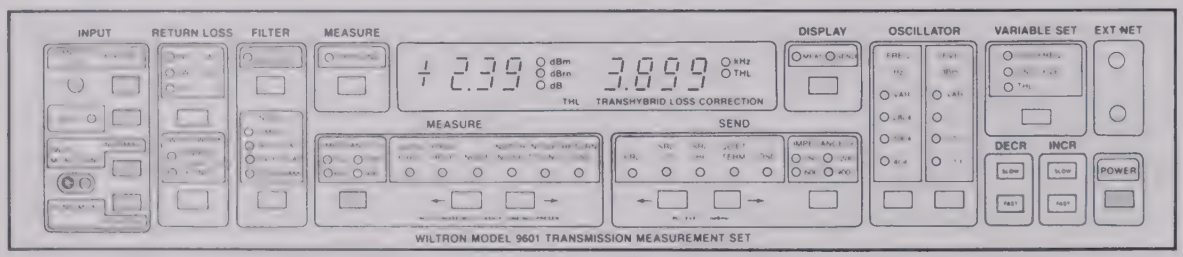


Figure 4-9. Typical Setup for Terminal-Balance Measurements on Carrier Channels

Table 4-11. Dialing and Talking on a 2-Wire Circuit

STEP	PROCEDURE
1	Set up the equipment to a trunk selected for testing as shown in Figure 4-10.
2	Press the NORMAL button (see figure).
3	Press the MEASURE IMPEDANCE Ω button until the required impedance LED lights - 600Ω or 900Ω.
4	Press the TALK DIAL button.
5	On the handset, enter the telephone number of the circuit to be dialed.
6	Once the connection is made, press the HOLD button until the HOLD LED lights, and then, release the TALK DIAL button.
7	To perform receiving measurements, refer to the appropriate measurement procedure in this section.
8	To perform sending tests: a. Depress the REVERSE button. The circuit under test is now connected to the selected sending circuitry with holding circuit in place. b. Refer to the appropriate sending procedure in this section. When performing sending tests on a 2W circuit that was dialed, do not depress the NORMAL button when it is called out in the sending procedure.



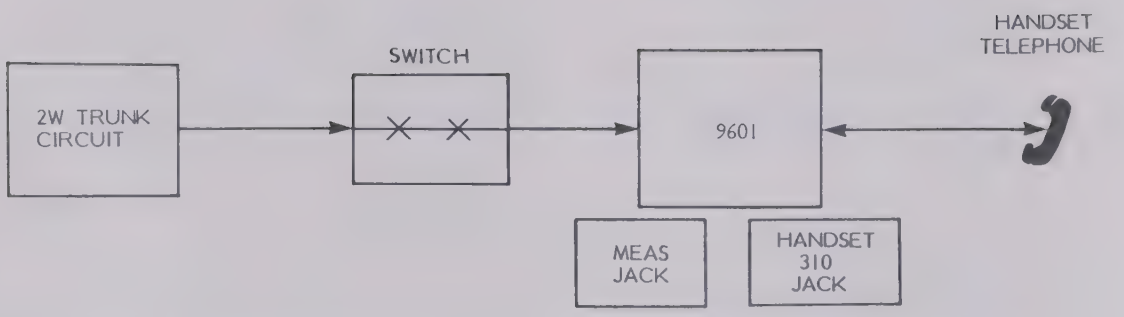


Figure 4-10. Typical Setup for Dialing and Talking on a 2-Wire Circuit

SECTION V

PERFORMANCE VERIFICATION

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5. INTRODUCTION

This section contains the 9601 performance verification procedures and a list of the test equipment and materials needed to perform the verification procedures.

5.01 REQUIRED TEST EQUIPMENT AND MATERIALS

Table 5-1 lists the test equipment and materials required for performance verification.

5.02 PERFORMANCE VERIFICATION PROCEDURES

Table 5-2 contains the 9601 performance verification procedures.

If the equipment gives an incorrect reading during a verification procedure, check that

Table 5-1. Test Equipment Required

TEST EQUIPMENT	REQUIRED CHARACTERISTICS
Level/Noise Receiver (TMS)	Input Level: +12 to -40 dBm Frequency Range: 50 Hz to 20 kHz Input Impedance: 600 and 900 ohms Accuracy: ± 1 Hz, ± 0.1 dB
Oscillator	Output Level: +10 to -40 dBm Frequency Range: 50 Hz to 20 kHz Output Impedance: 600 to 900 ohms Accuracy: ± 1 Hz, ± 0.1 dB
Variable Attenuator	Attenuator Range: 0 to 120 dB Input/Output Impedance: 600 ohms Frequency Range: 50 Hz to 20 kHz
Resistors	Values: 150 ohms, 900 ohms, and 1200 ohms Tolerance: ± 1%
Patch Cords	Various lengths
RMS Voltmeter (FLUKE 8800 or equivalent)	Input Range: 0 to 2V rms Frequency Range: 1000 Hz Accuracy: ± 0.1% or better

only the switches and controls mentioned in the procedure have been operated. Then, if the reading is still incorrect, refer to Section VI, Maintenance, of this manual to isolate the fault.

Table 5-2. 9601 Performance Verification Procedures

STEP	PROCEDURE	RESULTS
1	Press the 9601 POWER button.	The 9601 momentarily displays the software version, such as "01" The 9601 then momentarily displays the message "slf test". Finally, the 9601 display indicates 0.0 dBm, 1.004 kHz.
	Checking the Oscillator at 600Ω, 0.0 dBm	
2	On the 9601: a. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights. b. Press the SEND → button until the OSC LED lights. c. Press the MEASURE ← button until the LEVEL/FREQ LED lights. d. Press the SEND IMPEDANCE Ω button until the 600Ω LED lights. e. Press the DISPLAY button until the SEND LED lights. f. Press the OSCILLATOR FREQ button until the 1004 Hz LED lights. g. Patch the SEND jack to the input jack of the ac rms voltmeter.	—
3	On the ac rms voltmeter, connect a 600-ohm, 1% resistor to the input terminals.	Voltmeter indicates between 0.7657 and 0.7836V rms.

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
Checking the Oscillator at 600Ω, -10.0 dBm		
4	On the 9601, press the OSCILLATOR LEVEL button until the -10 dBm LED lights.	The voltmeter indicates between 0.2421 and 0.2478V rms.
Checking the Oscillator at 600Ω, -13.0 dBm		
5	On the 9601, press the OSCILLATOR LEVEL button until the -13 dBm LED lights.	The voltmeter indicates between 0.1714 and 0.1754V rms.
6	On the ac rms voltmeter, remove the 600-ohm resistor from the input terminal.	---
Checking the Oscillator at 900Ω, 0.0 dBm		
7	On the 9601: a. Press the SEND IMPEDANCE Ω button until the 900 Ω LED lights. b. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights.	---
8	On the ac rms voltmeter, connect a 900-ohm, 1% resistor to the input terminals.	Voltmeter indicates between 0.9378 and 0.9597V rms.
Checking the Oscillator at 900Ω, -10.0 dBm		
9	On the 9601, press the OSCILLATOR LEVEL button until the -10 dBm LED lights.	The voltmeter indicates between 0.2966 and 0.3035V rms.

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
	Checking the Oscillator at 900Ω, -13.0 dBm	
10	On the 9601, press the OSCILLATOR LEVEL button until the -13 dBm LED lights.	The voltmeter indicates between 0.2100 and 0.2148V rms.
11	On the ac rms voltmeter, remove the 900-ohm resistor from the input terminals.	---
	Checking the Oscillator at 1200Ω, 0.0 dBm	
12	On the 9601: a. Press the SEND IMPEDANCE Ω button until the 1200Ω LED lights. b. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights.	---
13	On the ac rms voltmeter, connect a 1200-ohm, 1% resistor to the input terminals.	Voltmeter indicates between 1.0829 and 1.1081V rms.
	Checking the Oscillator at 1200Ω, -10.0 dBm	
14	On the 9601, press the OSCILLATOR LEVEL button until the -10 dBm LED lights.	The voltmeter indicates between 0.3424 and 0.3504V rms.
	Checking the Oscillator at 1200Ω, -13.0 dBm	
15	On the 9601, press the OSCILLATOR LEVEL button until the -13 dBm LED lights.	The voltmeter indicates between 0.2424 and 0.2481V rms.
16	On the ac rms voltmeter, remove the 1200-ohm resistor from the input terminals.	---

Table 5–2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
	Checking the Oscillator at 150Ω, 0.0 dBm	
17	On the 9601: a. Press the SEND IMPEDANCE Ω button until the 150Ω LED lights. b. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights.	---
18	On the ac rms voltmeter, connect a 150-ohm, 1% resistor to the input terminals.	Voltmeter indicates between 0.3829 and 0.3918V rms.
	Checking the Oscilllator at 150Ω, -10.0 dBm	
19	On the 9601, press the OSCILLATOR LEVEL button until the -10 dBm LED lights.	The voltmeter indicates between 0.1211 and 0.1239V rms.
	Checking the Oscillator at 150Ω, -13.0 dBm	
20	On the 9601, press the OSCILLATOR LEVEL button until the -13 dBm LED lights.	The voltmeter indicates between 0.0857 and 0.0877V rms.
21	Remove the patch cord from the 9601 SEND jack and the ac rms voltmeter input jack.	---
	Checking the 9601 Level Meter at 2804 Hz	
22	On the 9601: a. Patch the SEND jack to the MEAS jack.	

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
22 (cont.)	b. Press the SEND IMPEDANCE Ω button until the 600Ω LED lights. c. Press the MEASURE IMPEDANCE Ω button until the 600Ω LED lights. d. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights. e. Press the OSCILLATOR FREQ button until the 2804 LED lights. f. Press the DISPLAY button until the MEAS LED lights.	The 9601 display indicates 0.0 dBm ± 0.1 dB, 2.804 kHz ± 1 Hz.
Checking the 9601 Level Meter at 404 Hz		
23	On the 9601, press the OSCILLATOR FREQ button until the 404 Hz LED lights.	The 9601 display indicates 0.0 dBm ± 0.1 dB, 0.404 kHz ± 1 Hz.
Checking the Quiet Termination		
24	On the 9601: a. Press the FILTER NOISE button until the C-MSG LED lights. b. Press the MEASURE → button until the NOISE LED button lights. c. Press the SEND ← button until the QUIET TERM LED lights.	The 9601 displays a - (minus) sign to indicate an underrange reading.

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
	Checking the Level and Frequency Measurements at 600Ω	
25	On the 9601: a. Press the MEASURE ← button until the LEVEL/FREQ LED lights. b. Press the SEND → button until the OSC LED lights. c. Press the OSCILLATOR FREQ button until the 1004 Hz LED lights.	The 9601 display indicates 0.0 dBm ± 0.1 dB, 1.004 kHz ± 1 Hz.
	Checking the Level and Frequency Measurements at 900Ω	
26	On the 9601: a. Press the MEASURE IMPEDANCE Ω button until the 900Ω LED lights. b. Press the SEND IMPEDANCE Ω button until the 900Ω LED lights.	The 9601 display indicates 0.0 dBm ± 0.1 dB, 1.004 kHz ± 1 Hz.
	Checking the Level and Frequency Measurements at 1200Ω	
27	On the 9601: a. Press the MEASURE IMPEDANCE Ω button until the 1200Ω LED lights. b. Press the SEND IMPEDANCE Ω button until the 1200Ω LED lights.	The 9601 display indicates 0.0 dBm ± 0.1 dB, 1.004 kHz ± 1 Hz.

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
	Checking the Level and Frequency Measurements at 150Ω	
28	On the 9601: a. Press the MEASURE IMPEDANCE Ω button until the 150Ω LED lights. b. Press the SEND IMPEDANCE Ω button until the 150Ω LED lights.	The 9601 display indicates 0.0 dBm, ± 0.1 dB, 1.004 kHz ± 1 Hz.
	Checking the Input Bridging Measurements	
29	On the 9601: a. Press the MEASURE IMPEDANCE Ω button until the 600Ω LED lights. b. Press the SEND IMPEDANCE Ω button until the 600Ω LED lights. c. Press the MEASURE BRIDGING button until the BRIDGING LED lights.	The 9601 display indicates +6.0 dBm ± 0.1 dB, 1.004 kHz ± 1 Hz.
	Checking the Notch Noise Measurements	
30	On the 9601: a. Press the MEASURE BRIDGING button until the BRIDGING LED turns off. b. Press the DISPLAY button until the SEND LED lights.	

Table 5–2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
30 (cont.)	c. Press the OSCILLATOR FREQ button until the VAR LED lights. d. Press the VARIABLE SET button until the OSC FREQ LED lights. e. Press the DECR and INCR buttons until the 9601 display indicates 1.300 kHz, 0.0 dBm. f. Press the NOISE button until the C-MSG LED lights. g. Press the DISPLAY button until the MEAS LED lights. h. Press the MEASURE → button until the NOTCH NOISE LED lights. i. Press the OSCILLATOR FREQ button until the 1004 Hz LED lights.	The 9601 display indicates +90 dBrn ± 1 dB. The NOTCH NOISE LED flashes. The 9601 display indicates less than +40 dBrn. The NOTCH NOISE LED stops flashing.
Checking the Return Loss Measurements		
31	On the 9601: a. Press the RETURN LOSS button until the 2W LED lights. b. Connect a 900-ohm 1% resistor to the MEAS jack. c. Press the 2W NETWORK button until the 600/900Ω +2.16 µF 1% LED lights. d. Press the MEASURE IMPEDANCE Ω button until the 900Ω LED lights.	

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
31 (cont.)	e. Press the MEASURE → button until the RETURN LOSS LED lights.	
	f. Press the SEND ← button until the SRL HI LED lights.	The 9601 display indicates 36.5 dB ± 0.5 dB.
	g. Press the SEND ← button until the SRL LO LED lights.	The 9601 display indicates 19.0 dB ± 0.5 dB.
	h. Press the SEND ← button until the ERL LED lights.	The 9601 display indicates 28.0 dB ± 0.5 dB.
	i. Press the 2W NETWORK button until the EXT NET LED lights.	
	j. Press the SEND → button until the SRL LO LED lights.	
	k. Connect a 900-ohm 1% resistor across the EXT NET jacks.	The 9601 displays a + (plus) sign to indicate an overrange reading.
	l. Remove the resistor from the EXT NET jacks.	
Checking the Noise-to-Ground Measurements		
32	On the 9601:	
	a. Press the MEASURE ← button until the NOISE TO GND LED lights.	
	b. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights.	
	c. Connect the ring lead of the SEND jack to pin 10 of connector P3 on the 9601 rear panel.	

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
32 (cont.)	d. Connect the tip lead of the SEND jack to the tip of the MEAS jack.	The 9601 display indicates +90 dBrn ± 1 dB. The frequency display is blank.
Checking the Handset, Talk/Dial, and Hold Functions		
33	On the 9601: a. Press the MEASURE ← button until the LEVEL/FREQ LED lights. b. Press the MEASURE IMPEDANCE Ω button until the 900Ω LED lights. c. Plug a handset into the HANDSET 310 jack. d. Patch the MEAS jack to a 2W telephone line. e. Press the NORMAL button. f. Press the TALK/DIAL button.	---
34	On the handset, dial the number of the office milliwatt source.	---
35	After connection to the milliwatt source, press the HOLD button on the 9601 and then release the TALK/DIAL button.	The hold LED lights and the 9601 display indicates the milliwatt source in dBm minus the telephone line loss.
Checking the Oscillator Variable Frequency		
36	On the 9601: a. Press the MEASURE IMPEDANCE Ω and the SEND IMPEDANCE Ω buttons until the 600 Ω LEDs light.	

Table 5–2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
36 (cont.)	b. Press the OSCILLATOR FREQ button until the VAR LED lights. c. Press the VARIABLE SET button until the OSC FREQ LED lights. d. Press the DISPLAY button until the SEND LED lights. e. Press the DECR FAST and DECR SLOW buttons until the display indicates 50 Hz, 0.0 dBm. f. Patch the SEND jack to the MEAS jack. g. Press the DISPLAY button until the MEAS LED lights.	The 9601 display indicates 50 Hz ± 1 Hz, 0.0 dBm ± 0.1 dB.
37	On the 9601: a. Press the DISPLAY button until the SEND LED lights. b. Press and release the INCR SLOW button. Note the frequency displayed on the 9601. c. Press the DISPLAY button until the MEAS LED lights.	The 9601 display indicates the frequency noted in step 37b ± 1 Hz, 0.0 dBm ± the tolerance listed in step 38.
38	a. Perform the procedures in step 37 for a number of frequencies between 50 Hz and 100 Hz. b. Perform the procedures in step 37 for a number of frequencies between 100 Hz and 300 Hz.	The 9601 display indicates the correct frequency ± 1 Hz, 0.0 dBm ± 0.5 dB. The 9601 display indicates the correct frequency ± 1 Hz, 0.0 dBm ± 0.2 dB.

Table 5–2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
39	On the 9601: a. Press the DISPLAY button until the SEND LED lights. b. Press and release the INCR FAST button. Note the frequency displayed on the 9601. c. Press the DISPLAY button until the MEAS LED lights.	The 9601 indicates the frequency noted in step 39b, 0.0 dBm ± the tolerances listed in step 40.
40	a. Perform the procedures in step 39 for a number of frequencies between 300 Hz and 3400 Hz. **NOTE:** Pressing the INCR FAST button causes the oscillator to skip from 2450 to 2750 Hz so it does not send out a 2600 Hz tone. b. Perform the procedures in step 39 for a number of frequencies between 3.400 and 10.0 kHz. **NOTE:** Pressing the INCR FAST button causes the oscillator to skip from 3980 to 4020 Hz so it does not send out a 4000 Hz tone. c. Perform the procedures in step 39 for a number of frequencies between 10.0 and 20.0 kHz.	The 9601 indicates the correct frequency ± 1 Hz, 0.0 dBm ± 0.1 dB. The 9601 indicates the correct frequency ± 1 Hz, 0.0 dBm ± 0.2 dB. The 9601 indicates the correct frequency ± 5 Hz, 0.0 dBm ± 0.5 dB.
	Checking the Oscillator Variable Level	
41	On the 9601: a. Press the DISPLAY button until the SEND LED lights.	

Table 5–2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
41 (cont.)	b. Press the OSCILLATOR FREQ button until the 1004 Hz LED lights. c. Press the OSCILLATOR LEVEL button until the VAR LED lights. d. Press the VARIABLE SET button until the OSC LEVEL LED lights. e. Press the INCR FAST button until the display indicates 1.004 kHz, +10.0 dBm. f. Press the DISPLAY button until the MEAS LED lights.	The 9601 display indicates 1.004 kHz ± 1 Hz, +10.0 dBm ± 1 dB.
42	On the 9601: a. Press the DISPLAY button until the SEND LED lights. b. Press and release the DECR FAST button. Note the level displayed on the 9601. c. Press the DISPLAY button until the MEAS LED lights. d. Perform procedures 42a through 42c for a number of levels between +12.0 dBm and -40.0 dBm. e. Connect a variable attenuator between the SEND and MEAS jacks and set the attenuator to -20.0 dB. f. Press the DISPLAY button until the SEND LED lights.	The 9601 indicates the level noted in step 42b ± 0.1 dB, 1.004 kHz ± 1 Hz.

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
42 (cont.)	g. Press the DECR FAST button until the display indicates 1.004 kHz, -33.0 dBm. h. Press the DISPLAY button until the MEAS LED lights.	 The 9601 indicates a - (minus) sign to indicate an underrange reading.
	Checking the Level Protect Filter	
43	On the 9601: a. Press the FILTER button until the LEVEL PROTECT LED lights. b. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights. c. Press the OSCILLATOR FREQ button until the VAR LED lights. d. Press the VARIABLE SET button until the OSC FREQ LED lights. e. Press the DISPLAY button until the SEND LED lights. f. Press the INCR and DECR buttons until the display indicates 10.0 kHz, 0.0 dBm. g. Press the DISPLAY button until the MEAS LED lights. h. Repeat steps 43e through g for a number of frequencies between 3500 Hz and 420 Hz. i. Repeat steps 43e through g for 180 Hz.	 The 9601 indicates 10.0 kHz ± 1 Hz and less than -3.2 dBm. The 9601 indicates the correct frequency ± 1 Hz, 0.0 dBm ± 0.1 dB. The 9601 indicates 180 Hz ± 1 Hz and less than -4.2 dBm.

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
43 (cont.)	j. Repeat steps 43e through g for 60 Hz. k. Press the FILTER button until the LEVEL PROTECT LED turns off.	The 9601 indicates 60 Hz ± 1 Hz and less than -45 dBm.
Checking the Frequency Response Measurements		
44	On the 9601: a. Press the OSCILLATOR FREQ button until the 1004 Hz LED lights. b. Press the OSCILLATOR LEVEL button until the VAR LED lights. c. Press the VARIABLE LEVEL button until the OSC LEVEL LED lights. d. Press the DISPLAY button until the SEND LED lights. e. Press the INCR and DECR buttons until the display indicates 1.004 kHz, -40.0 dBm. f. Press the DISPLAY button until the MEAS LED lights. g. Press the MEASURE → button until the FREQ RESP LED lights. h. Press the MEASURE ← button until the LEVEL/FREQ LED lights. i. Repeat steps 44d through h for 1.004 kHz and -30.0, -20.0, -10.0, 0.0, and +10.0 dBm.	The 9601 indicates -40.0 dBm ± 0.1 dB, 1.004 kHz ± 1 Hz. The 9601 indicates 0.0 dB ± 0.1 dB, 1.004 kHz ± 1 Hz. The 9601 indicates 1.004 kHz ± 1 Hz and +10.0, +20.0, +30.0, +40.0, and +50.0 dB ± 0.1 dB, respectively.

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
	Checking the C-Message Filter	
45	On the 9601: a. Press the MEASURE → button until the NOISE LED lights. b. Press the NOISE button until the C-MSG LED lights. c. Press the OSCILLATOR LEVEL button until the -10 dBm LED lights. d. Press the OSCILLATOR FREQ button until the VAR LED lights. e. Press the VARIABLE SET button until the OSC FREQ LED lights. f. Press the DISPLAY button until the SEND LED lights. g. Press the INCR and DECR buttons until the display indicates 1.000 kHz, -10.0 dBm. h. Press the DISPLAY button until the MEAS LED lights. i. Repeat steps 45f through h for a number of frequencies between 60 Hz and 5000 kHz.	The 9601 indicates +80 dBrn ± 0.1 dB. (This is the reference level for the rest of the C-Message Filter checks.) The frequency display is blank. The 9601 indicates a noise reading within ± 1 dB of the corresponding point on the C-Message Filter Weighting characteristic response curve for each frequency (see Figure 5-1).

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
	Checking the 3 kHz Flat Filter	
46	On the 9601: a. Press the NOISE button until the 3 kHz FLAT LED lights. b. Press the DISPLAY button until the SEND LED lights. c. Press the INCR and DECR buttons until the display indicates 1.000 kHz, -10.0 dBm. d. Press the DISPLAY button until the MEAS LED lights. e. Repeat steps 46b through d for a number of frequencies between 60 Hz and 3.0 kHz.	The 9601 indicates +80 dBrn ± 0.1 dB. (This is the reference level for the rest of the 3 kHz Flat Filter checks.) The frequency display is blank. The 9601 indicates a noise reading within the tolerance shown on the corresponding point on the 3 kHz Flat Filter Weighting Characteristic response curve for each frequency (see Figure 5-2).
	Checking the 15 kHz Flat Filter	
47	On the 9601: a. Press the NOISE button until the 15 kHz FLAT LED lights. b. Press the DISPLAY button until the SEND LED lights.	

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
47 (cont.)	c. Press the INCR and DECR buttons until the display indicates 5.0 kHz, -10.0 dBm.	
	d. Press the DISPLAY button until the MEAS LED lights.	The 9601 indicates +80 dBrn ± 0.1 dB. (This is the reference level for the rest of the 15 kHz Flat Filter checks.) The frequency display is blank.
	e. Repeat steps 47b through d for a number of frequencies between 300 Hz and 15.0 kHz.	The 9601 indicates a noise reading within the tolerance shown on the corresponding point on the 15 kHz Flat Filter Weighting Characteristic response curve for each frequency (see Figure 5-3).
	Checking the Program Filter	
48	On the 9601: a. Press the NOISE button until the PROGRAM LED lights. b. Press the DISPLAY button until the SEND LED lights. c. Press the INCR and DECR buttons until the display indicates 1.000 kHz, -10 dBm.	
	d. Press the DISPLAY button until the MEAS LED lights.	The 9601 indicates +80 dBrn ± 0.1 dB. (This is the reference level for the rest of the Program Filter checks.) The frequency display is blank.

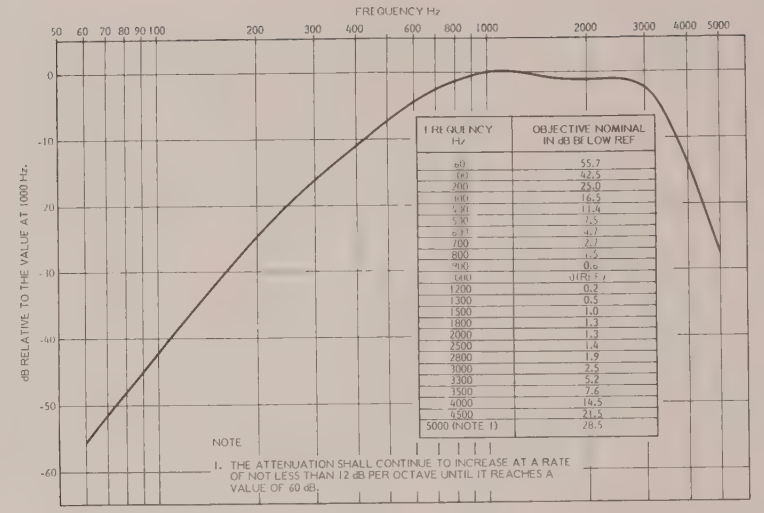

Figure 5-1. 9601 C-Message Filter Weighting Characteristic

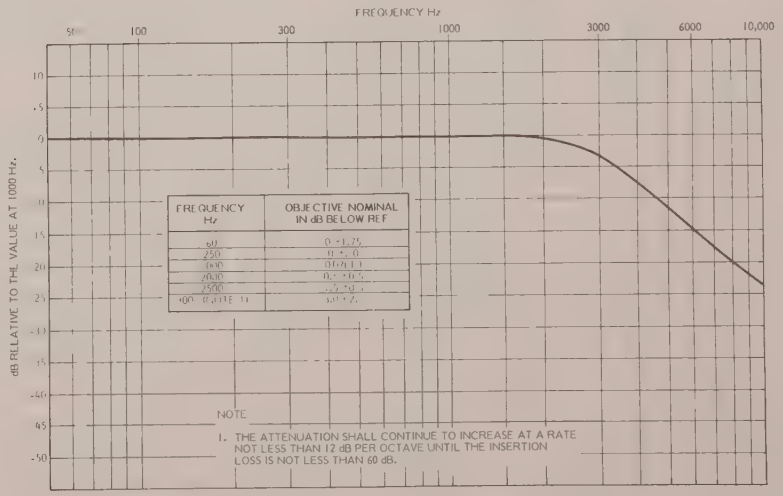

Figure 5-2. 9601 3 kHz Flat Filter Weighting Characteristic

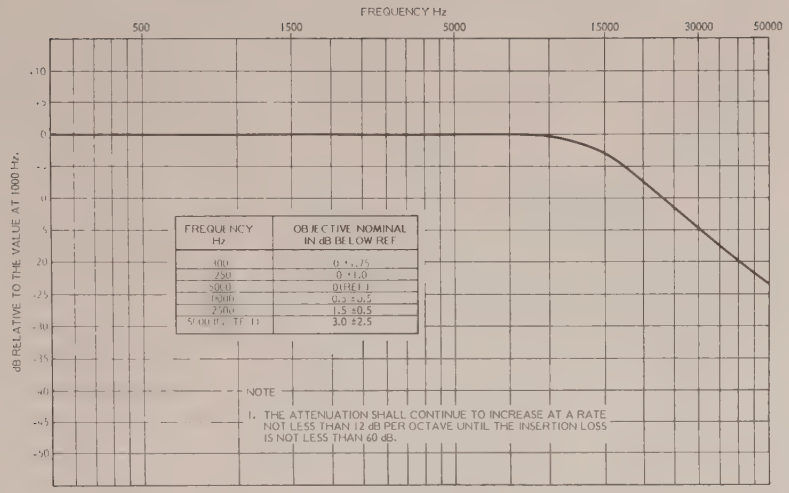
FREQUENCY Hz
500
1500
5000
15000
30000
50000
dB RELATIVE TO THE VALUE AT 1000 Hz.
FREQUENCY Hz
OBJECTIVE NOMINAL IN dB BELOW REF
NOTE
1. THE ATTENUATION SHALL CONTINUE TO INCREASE AT A RATE NOT LESS THAN 12 dB PER OCTAVE UNTIL THE INSERTION LOSS IS NOT LESS THAN 60 dB.

Figure 5-3. 9601 15 kHz Flat Filter Weighting Characteristic

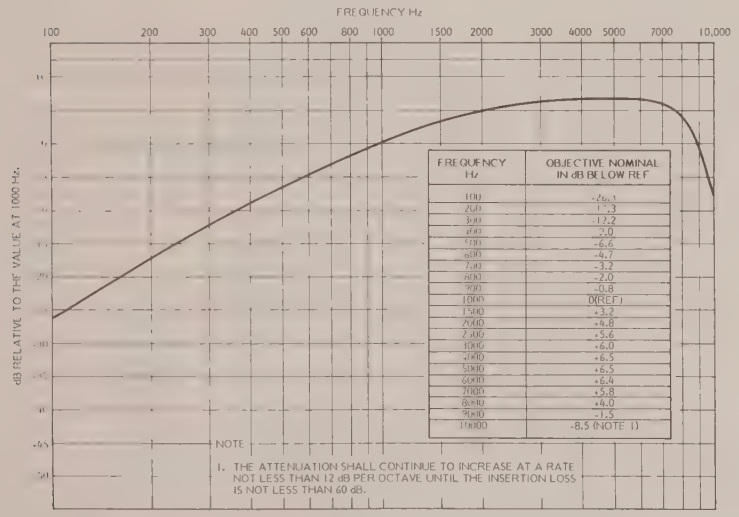

Figure 5-4. 9601 Program Filter Weighting Characteristic

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
48 (cont.)	e. Repeat steps 48b through d for a number of frequencies between 100 Hz and 10.0 kHz.	The 9601 indicates a noise reading ± 1 dB of the corresponding point on the Program Filter Weighting characteristic response curve for each frequency (see Figure 5-4).
	Checking the THL Variable Set Function	
49	On the external oscillator, set the output to -40.0 dBm, 600 ohms, 1004 Hz.	---
50	On the 9601: a. Patch the external oscillator output jack to the left side MEAS jack. b. Press the MEASURE → button until the RETURN LOSS LED lights. c. Press the NOISE button until the C-MSG LED lights. d. Press the SEND ← button until the ERL LED lights. e. Press the RETURN LOSS button until the 4W 0/0 LED lights. f. Press the VARIABLE SET button until the THL LED lights. g. Press the DISPLAY button until the MEAS LED lights.	The 9601 indicates +30.0 dB ± 0.5 dB, 0.0 dB THL.

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
50 (cont.)	h. Continually press and release the INCR SLOW button until the THL display indicates 30.0 dBm.	The 9601 indication decreases in 1 dB steps from 30 to 0 dB while the THL reading increases in 1 dB steps from 0.0 to 30.0 dB.
Checking the Normal and Reverse Functions		
51	On the external oscillator, set the output to 0.0 dBm, 600 ohms, 1004 Hz.	---
52	On the 9601: a. Press the DISPLAY button until the MEAS LED lights. b. Press the MEASURE ← button until the LEVEL/FREQ LED lights. c. Press the NORMAL button.	The 9601 indicates 0.0 dBm ± 0.5 dB, 1.004 kHz.
53	On the external level meter, select the level function, 600-ohm input impedance.	---
54	On the 9601: a. Press the DISPLAY button until the SEND LED lights. b. Press the SEND → button until the OSC LED lights. c. Press the REVERSE button. d. Patch the left side MEAS jack to the output jack of the external level meter.	The external level meter indicates 0.0 dBm ± 0.2 dB, 1.004 Hz ± 2 Hz.

Table 5-2. 9601 Performance Verification Procedures (Continued)

STEP	PROCEDURE	RESULTS
54 (cont.)	e. Patch the right side SEND jack to the output jack of the external oscillator.	
	f. Press the DISPLAY button until the MEAS LED lights.	The 9601 indicates 0.0 dBm ± 0.5 dB, 1.004 Hz ± 2 Hz.
	g. Press the NORMAL button.	
	h. Patch the right side SEND jack to the input jack of the external level meter.	The external level meter indicates 0.0 dBm ± 0.2 dB, 1.004 Hz ± 2 Hz.

SECTION VI

MAINTENANCE

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6. INTRODUCTION

This section contains the 9601 fault-isolation and calibration procedures. Also, it includes a list of the error codes, a list of the required maintenance equipment and materials, instructions to remove and install circuit boards in the 9601, and a description of the WILTRON instrument exchange policy.

6.01 REQUIRED TEST EQUIPMENT AND MATERIALS

To perform the fault-isolation procedures, the following test equipment and materials are required.

- Level/noise receiver (TMS) with level measuring capability at 0 dBm ±0.1 dB, 600-ohm input impedance, 1004 Hz ±1 Hz.
- Oscillator, such as the WILTRON 9102A DTMS or equivalent, with sine-wave output at 0.0 dBm ±0.1 dB, 600-ohm output impedance, 1004 Hz ±1 Hz.
- Digital Voltmeter, 4-1/2 digits, 0-100 Vdc and ac rms measuring capability.
- 600-ohm ±0.1% termination resistor.
- 900- and 600-ohm ±1% termination resistors.
- Patch cords of various lengths, bantam-type.

6.02 FAULT-ISOLATION PROCEDURES

Table 6-1 contains the 9601 fault-isolation procedures. Perform the fault-isolation procedures in sequence. If the equipment gives an incorrect result during a procedure, be sure that only the switches and controls mentioned in the procedure have been operated. If the procedure fails to isolate the fault, contact WILTRON Telecom Customer Service at (415) 969-6500.

6.03 ERROR CODE DISPLAY

Table 6-2 lists the 9601 error codes. An error code appears on the dis-

play when the 9601 fails to pass one of the self-test checks. Even though the display indicates an error code, the 9601 will continue to operate correctly except for those measurements affected by the indicated error code.

6.04 LEVEL, OSCILLATOR, AND RETURN LOSS CALIBRATION

Table 6-3 contains the calibration procedures for the level/noise receiver, oscillator, and return loss circuitry. The calibration adjustments are made to potentiometers on the 9601 rear panel. If the equipment gives an incorrect result during a procedure, be sure that only the switches and controls mentioned in the procedure have been operated. If the calibration procedure still fails to give the correct results, refer to Table 6-1.

6.05 REMOVING AND INSTALLING A 9601

Table 6-4 contains procedures to remove or install a 9601 from a relay rack.

6.06 REPLACING PC BOARDS IN A 9601

Table 6-5 contains procedures to remove or install PC boards in a 9601.

6.07 INSTRUMENT EXCHANGE POLICY

WILTRON Company will exchange a defective 9601 or PC board for a working unit. There are two exchange categories: Warranty and non-warranty.

A. Warranty Exchange

To exchange an in-warranty defective 9601 or PC board, contact WILTRON Telecom Customer Service at (415) 969-6500 and order a replacement unit. The warranty period is one year from the shipment date. After receiving the replacement unit from WILTRON, remove the defective unit and install the replacement 9601 or PC board. Next, carry out the performance verification procedures in Section V. Pack the defective 9601 or PC board in the shipping container and return it to WILTRON with a detailed malfunction description.

B. Non-Warranty Exchange

To exchange an out-of-warranty defective 9601 or PC board, obtain a purchase order number before calling WILTRON Telecom Customer Service. Follow the procedures described above for verifying the replacement and returning the defective unit.

Table 6-1. 9601 Fault-Isolation Procedures

STEP	PROCEDURE	RESULTS
	Applying Power and Observing the 9601 Display	
1	Press the POWER button on the 9601. **NOTE:** If, after applying power to the 9601, the display is blank, full of nonsense characters, flashing, or if all the front panel LEDS are lit or flashing, turn off the 9601 power and repeat step 1. If the 9601 still fails to give the correct results after repeating step 1, replace the 9601 (Table 6-4).	The following actions occur: a. The 9601 momentarily displays the software version, such as "01". b. The 9601 then momentarily displays the message "slf test". c. If any error codes (such as "ER 01") are displayed refer to Table 6-2. d. If the software version and "slf test" are displayed, go to step 3, if not, go to step 2.

Table 6-1. 9601 Fault-Isolation Procedures (Continued)

STEP	PROCEDURE	RESULTS
	Checking -48V Input on the Rear Panel	
2	Connect the DVM between the -48V and GND terminals on TB1.	If the DVM indicates between -42.5 and -52.0 Vdc, go to step 3; if not, check the power cabling and the associated fuse in the c.o. distribution panel.
3	Remove fuse F1 and check its continuity.	If the fuse is good, repeat step 1. If the 9601 still gives incorrect results, replace the 9601 (Table 6-4). If the fuse is defective, replace it with a similar 1A slow-blow fuse and repeat step 1. If the 9601 still gives incorrect results, replace the 9601 (Table 6-4).
	Checking the 9601 Front Panel LEDs and Display	
4	Remove any patch cords plugged into the SEND and MEAS jack.	—
5	Check that the following LEDs light on the 9601: 4W 0/0 600/900Ω + 2.16 µF 1% 3 kHz FLAT MEASURE IMPEDANCE 600Ω MEASURE LEVEL/FREQ SEND OSC SEND IMPEDANCE 600Ω	If the listed LEDs light, go to step 6. If one or more but not all of the LEDs fails to light, repeat step 1.

Table 6-1. 9601 Fault-Isolation Procedures (Continued)

STEP	PROCEDURE	RESULTS
5 (cont.)	DISPLAY SEND OSCILLATOR FREQ VAR OSCILLATOR LEVEL VAR VARIABLE SET OSC FREQ	
6	Check that the 9601 display indicates 0.0 dBm, 1.004 kHz.	If the display gives the correct readings, go to step 7; if not, perform the oscillator level calibration and level/noise receiver calibration procedures in Table 6-3.
	Checking the Sender Board	
7	On the 9601, patch the SEND jack to the input of the DVM or another level/noise receiver (TMS). Terminate the input of the measuring device with a 600Ω, 1% load.	If the DVM indicates 0.7656 to 0.7836V rms or the level/noise receiver indicates 0.0 dBm ± 0.1 dB, go to step 8; if not, perform the oscillator level calibration procedures in Table 6-3. If still unable to obtain the correct result after performing the calibration in Table 6-3, replace the Sender board (Table 6-5).
	Checking the Receiver Board	
8	If the sender board is known to be good, patch the SEND jack to the MEAS jack on the 9601. If the sender board is defective, patch the 9601 MEAS jack to an external oscillator set to 0.0 dBm, 1004 Hz, 600-ohm input impedance.	The 9601 display indicates 0.0 dBm, ± 0.1 dB, 1004 kHz; if not, perform the level/noise receiver procedures in Table 6-3.

Table 6-1. 9601 Fault-Isolation Procedures (Continued)

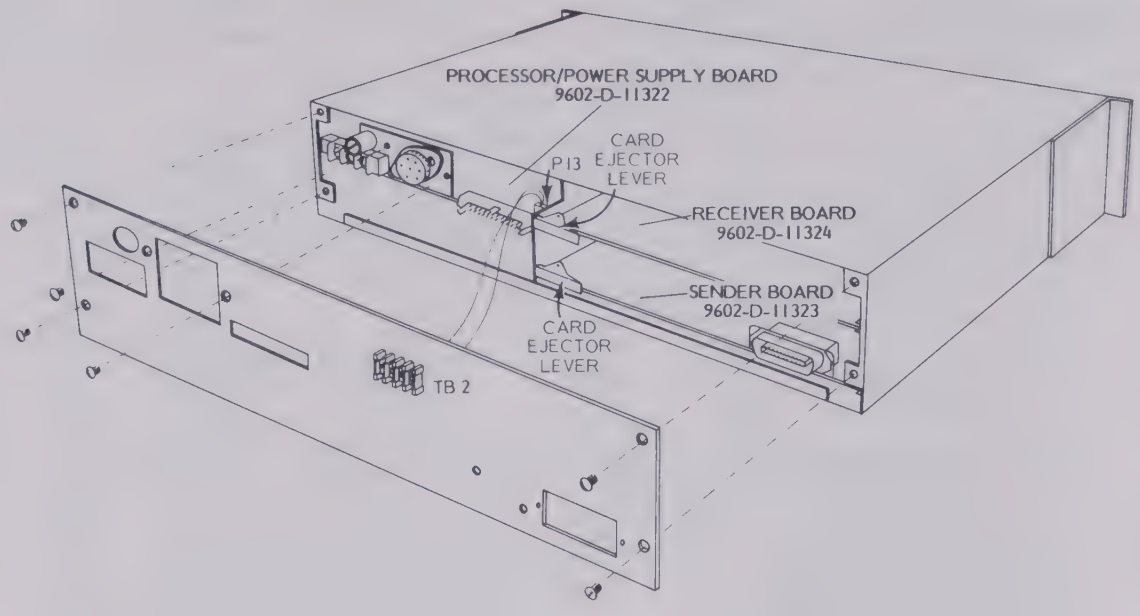
STEP	PROCEDURE	RESULTS
8 (cont.)	**NOTE:** If the sender board is known to be defective and a 0.0 dBm, 1004 Hz signal source in unavailable, replace the 9601 (Table 6-4).	If still unable to obtain the correct results, replace the receiver board (Table 6-5).
	Checking the 9496 Remote Display	
9	On the 9601: a. Patch the SEND jack to the MEAS jack. b. Press the MEASURE → button until the LEVEL/FREQ LED lights. c. Press the MEASURE IMPEDANCE Ω button until the 900Ω LED lights. d. Press the SEND → button until the OSC LED lights. e. Press the SEND IMPEDANCE Ω button until the 900Ω LED lights. f. Press the DISPLAY button until the MEAS LED lights. g. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights. h. Press the OSCILLATOR FREQ button until the 1004 Hz LED lights.	--- If the Remote Display indicates 0.0 dBm ± 0.1 dB, 1.004 kHz ± 1 Hz, go to step 9i.

Table 6-1. 9601 Fault-Isolation Procedures (Continued)

STEP	PROCEDURE	RESULTS
9 (cont.)		If the Remote Display gives incorrect or unreadable indications, go to step 10.
	i. Press the MEASURE → button until the NOISE LED lights.	
	j. Press the NOISE button until the C-MSG LED lights.	If the Remote Display indicates +90 dBrn ± 1 dB, go to step 9k; if not, go to step 10.
	k. Remove the patch cord from the SEND and MEAS jacks. Connect a 900-ohm 1% termination resistor to the MEAS jack.	
	l. Press the REFERENCE NETWORK button until the 600/900Ω +2.16 μF 1% LED lights.	
	m. Press the MEASURE → button until the RETURN LOSS LED lights.	
	n. Press the SEND ← button until the SRL HI LED lights.	If the Remote Display indicates 36.5 dB ± 0.5 dB, the Remote Display is operating properly and the Remote Display testing is complete; if not, go to step 10.
10	Substitute a known good 9496 Remote Display for the one being tested. If another Remote Display is unavailable, replace the 9601 Processor/Power Supply board (Table 6-5) and repeat step 9. If both are unavailable, replace the 9601 (Table 6-4).	—

Table 6-2. 9601 Error Codes

ERROR CODES	PROBABLE CAUSE	ACTION
Er01	EPROM No. 1 (U30) checksum error on processor/power supply board.	Replace the processor/power supply board (Table 6-5).
Er02	EPROM No. 2 (U31) checksum error on processor/power supply board.	Replace the processor/power supply board (Table 6-5).
Er03	EPROM No. 3 (U32) checksum error on processor/power supply board.	Replace the processor/power supply board (Table 6-5).
Er04	RAM (U22/23) check error on processor/power supply board.	Replace the processor/power supply board (Table 6-5).
Er05	Defective receiver, or sender board (level/frequency counter calibration check is out-of-tolerance).	Substitute the receiver and sender boards until the fault is corrected (Table 6-5).
Er06	Sender board oscillator frequency out-of-tolerance.	Substitute the sender and receiver boards until the fault is corrected (Table 6-5).
Er07	Receiver or processor/power failure.	Substitute the receiver and processor/power supply boards until the fault is corrected (Table 6-5).
no PC bd	When DISPLAY SEND is selected, sender board not plugged in. When DISPLAY MEAS is selected, receiver board not plugged in.	Check sender board mating with PC board connectors. Check receiver board mating with PC board connectors.



WARNING

To remove the Processor/Power Supply board, grasp and pull on the circuit board itself. Do not grasp and pull on either terminal block TB1, fuse F1, voltage regulator VR1, or connector P2.

Figure 6-1. Replacing PC Boards in the 9601 Transmission Measurement Set

Table 6-3. 9601 Transmission Measurement Set Calibration Procedures

STEP	PROCEDURE	RESULTS
	Oscillator Level Calibration	
1	On the 9601: a. Patch the SEND jack to the input jack of a DVM with 600 ohm ± 0.1 terminated impedance. b. Press the SEND → button until the OSC LED lights. c. Press the SEND IMPEDANCE Ω button until the 600Ω LED lights. d. Press the DISPLAY button until the SEND LED lights. e. Press the OSCILLATOR LEVEL button until the 0 dBm LED lights. f. Press the OSCILLATOR FREQ button until the 1004 Hz LED lights. g. On the rear panel, adjust R13 OCS LEVEL CAL until the DVM indicates 0.7746 V rms ± 9 mV.	9601 oscillator output is now calibrated at 0.0 dBm.
	Level/Noise Receiver Calibration	
	NOTE: The oscillator level calibration procedure must be performed before beginning this procedure.	

Table 6-3. 9601 Calibration Procedures (Continued)

STEP	PROCEDURE	RESULTS
2	On the 9601: a. Press the MEASURE ← button until the LEVEL/FREQ LED lights. b. Press the MEASURE IMPEDANCE Ω button until the 600Ω LED lights. c. Press the DISPLAY button until the MEAS LED lights. d. Patch the SEND jack to the MEAS jack. e. On the rear panel, adjust R129 RECEIVER CAL until the 9601 display indicates 0.0 dBm with the polarity sign alternating between + (plus) and - (minus).	The 9601 level/noise receiver is now calibrated at 0.0 dBm.
	Return Loss Calibration	
3	**NOTE:** The oscillator level calibration and level/noise receiver calibration procedures must be performed before beginning this procedure. For the 9601: a. Press the MEASURE button until the RETURN LOSS LED lights. b. Press the MEASURE IMPEDANCE button until the 600Ω LED lights. c. Press the SEND button until the ERL LED lights. d. Press the SEND IMPEDANCE button until the 600Ω LED lights. e. Press the DISPLAY button until the MEAS LED lights.	

Table 6-3. 9601 Calibration Procedures (Continued)

STEP	PROCEDURE	RESULTS
	f. Patch the SEND jack to the MEAS jack. g. On the rear panel, adjust R28 RED LOSS SEND CAL until the 9601 display indicates 0.0 dB with the polarity sign alternating between + (plus) and - (minus).	The 9601 return loss transmitter is now calibrated.

Table 6-4. Removing and Installing a 9601 Transmission Measurement Set from a Relay Rack

STEP	PROCEDURE
	Removing the Panel
1	Release the POWER BUTTON on the 9601.
2	On the 9601 rear panel: a. Disconnect the 24-pin connector from connector P3. b. Note the color codes of the wires and their location on TB1. c. Disconnect the TB1 wiring.
3	On the 9601 front panel: a. Remove the four No. 12-24 screws that secure the panel to the relay rack. b. Pull out the panel from the relay rack.
	Installing the Panel
4	Slide the panel into its slot (2 rack spaces) in the relay rack.
5	Secure the panel with the four No. 12-24 screws.
6	On the 9601 rear panel, reconnect all the cables and wires that were disconnected in step 2 of the removal instructions above.
7	Press the POWER button on the 9601.

Table 6-5. Replacing PC Boards in the 9601 Transmission Measurement Set

STEP	PROCEDURE
	Removing the PC Boards (See Figure 6-1)
1	Release the POWER button.
2	On the 9601 rear panel: a. Disconnect the 24-pin connector from connector P3. b. Note the color codes of the wires and their location on TB1. c. Disconnect the TB1 wiring. d. Remove the six screws that secure the rear panel. e. Disconnect P13 from the Processor/Power Supply board. f. Remove the rear panel. g. Locate and then pull out the desired circuit board(s).
	Installing PC Boards (See Figure 6-1)
3	Insert the circuit board(s) as shown in the figure.
4	Replace the rear panel and secure it with the six screws.
5	Reconnect the wiring and cables that were disconnected in step 2 of the removal instructions above.
6	Press the POWER button on the 9601.

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